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BUTTERFLY & OTHER INVERTEBRATES CLUB INC.

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- To hold information meetings and organise excursions around the theme of invertebrates
- To promote the conservation of the invertebrate habitat and encourage the growing of butterfly host plants
- To promote research into invertebrates
- To encourage the construction of invertebrate friendly habitats in urban areas

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If you wish to submit an item for the publication the following deadlines apply:
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Cover image: Photograph courtesy of Alexander Davies, Black Rock Scorpion (*Urodacus manicatus*)

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Hello from the President

I welcome all to issue 103 of *Metamorphosis Australia*. As always, the standard of manuscripts submitted is way above par and we are delving into a range of invertebrate groups which is pleasing to see. The high standard of articles in *Metamorphosis Australia* is a credit to the willingness of a range of authors who have submitted, and the hard-working editorial committee whose role it is to maintain this high standard. Thus, I take the opportunity here to thank once again the management committee for the production of *Metamorphosis Australia* 103.

The management committee has also responded well to refreshing the club in several areas. You will have noticed our new rejuvenated website which now has all the issues of *Metamorphosis Australia*, dating back to No 1, available on-line. Additionally, the subscription payment has been updated for members, such that each member's subscription will be adjusted to renew on the 1st January each year, thanks to Bernie. The magazine now will be published on a six-monthly basis (next edition 104 in September) to allow authors more time to submit their articles and to let their article be peer reviewed.

Finally, I would like to take this opportunity to thank our hard-working secretary who goes above and beyond what is required. I think we are truly blessed to have her supporting our club in such a way.

My sincere regards

Trevor

Life history notes on the White Migrant, *Catopsilia pyranthe crokera* (W.S. Macleay, 1826) (Lepidoptera: Pieridae)

Wesley Jenkinson

Introduction

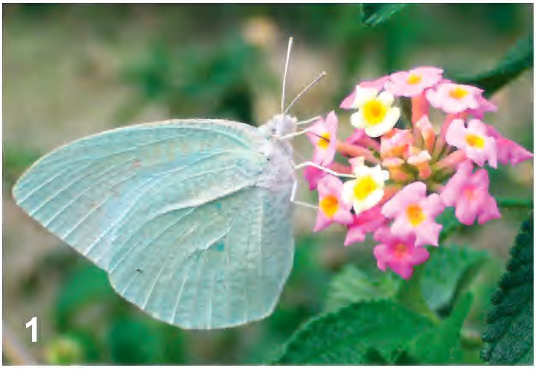

Fig. 1. Adult feeding on Lantana flower

The White Migrant *Catopsilia pyranthe crokera* (W.S. Macleay, 1826) is known sporadically from all Australian states except Tasmania (Braby 2016). The mapped range of Braby 2000 has considerably increased in Braby 2016, specifically areas in south-western Queensland, north-western New South Wales, much of the Northern Territory and northern Western Australia. This new range closely resembles the range-fill map of the species indicated by Common and Waterhouse (1981). Although widespread in its distribution, it is less frequently encountered in wet coastal areas and rainforests than in drier areas.

Adult egg-laying is not restricted to any specific habitat and the butterflies can often breed in suburban gardens. The adults tend to be transitory and will usually disperse from their breeding site within a few days of emergence.

Migrations occur irregularly (Braby 2000), but in subcoastal south-eastern Queensland, I have not observed migrations of any significance, unlike that of the Lemon Migrant (*C. pomona*) which is regularly seen migrating. Thus, in this region I would consider *C. pyranthe* movement as dispersal from the breeding sites.

Description

It should be noted that adults of the exotic Cabbage White (*Pieris rapae*), male Yellow Albatross (*Appias paulina*) and pale forms of *C. pomona* could be confused with this species by the untrained eye. Notably, *C. pyranthe* on the underside of the wings has light brown striations across the wings which are absent in the other species. It also has a stronger flight than *P. rapae* and is mostly larger. Live adults have a pale greenish-blue tinge to the wings which fades over time in set specimens.

Individual specimens show some variation in size with almost no variation in the width of the black margin. This species has two distinct forms; a dark form and a pale form. Dark forms have black antennae whilst pale forms have pink (Braby 2000) or brownish pink antennae. Both forms can be on the wing at the same time throughout the year (Braby 2000) and these forms appear to be much less seasonally influenced than the forms of *C. pomona.*

In flight, the sexes of both seasonal forms can be difficult to distinguish, although the female dark form, having wider black wing margins on the upperside, can often be distinguished. Males have a patch of whitish hairs on the underside of the forewing dorsum (inner margin) with a corresponding white oval patch of sex scales between the costa and vein R5 on the upperside of the hindwing.

Adults of both sexes feed on a broad range of native and exotic flowers. When feeding, the wings usually remain closed, and generally the adults do not fly higher than 2–3 m. Wingspans for the typical dark form are: males 50 mm and females 60 mm (Figs 2–5). Wingspans for the typical pale form are: males 58 mm and females 57 mm (Figs 6–9). Two female variations are pictured (Figs 10–11).

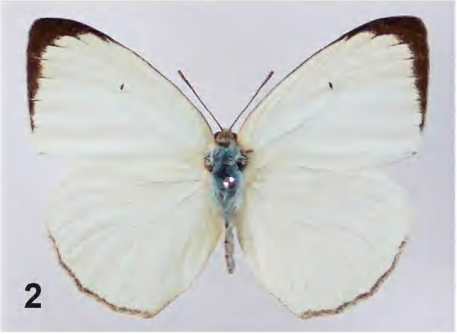

Fig. 2. Male upper (dark form)

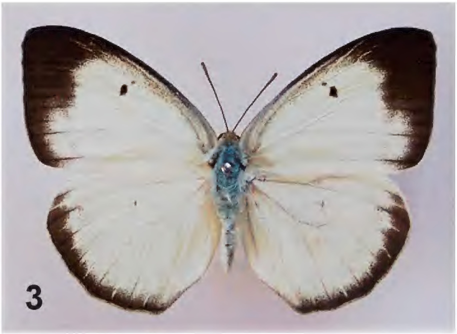

Fig. 3. Female upper (dark form)

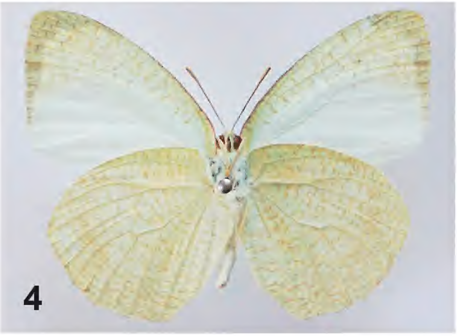

Fig. 4. Male under (dark form)

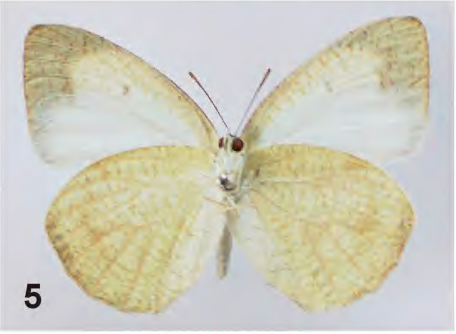

Fig. 5. Female under (dark form)

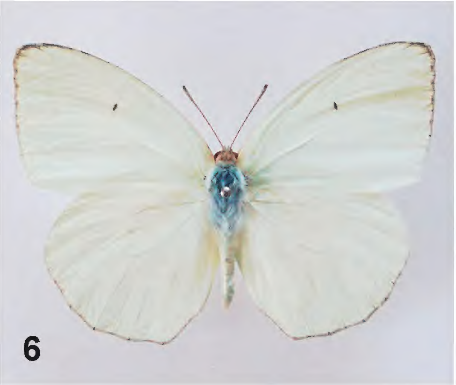

Fig. 6. Male upper (pale form)

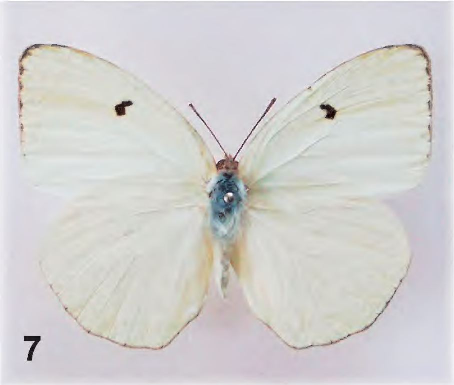

Fig. 7. Female upper (pale form)

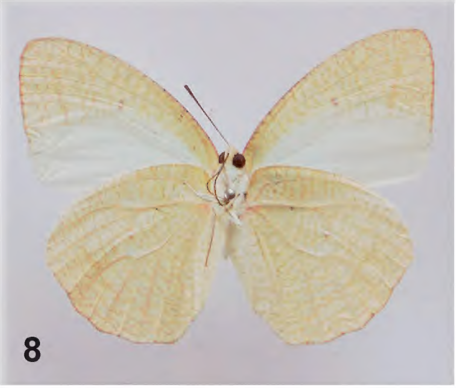

Fig. 8. Male under (pale form)

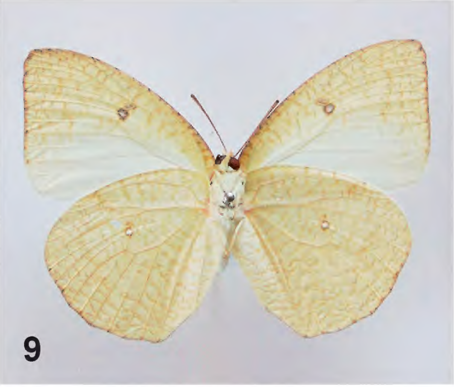

Fig. 9. Female under (pale form)

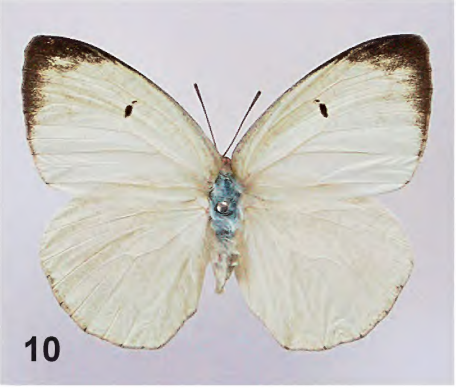

Fig. 10. Female upper (dark form variation)

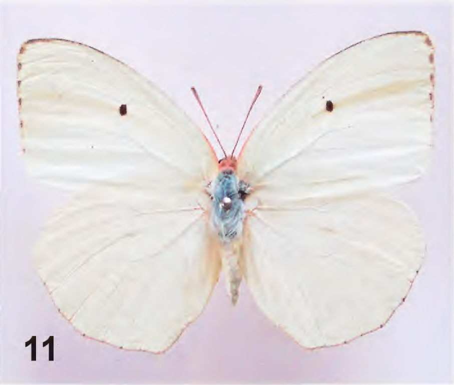

Fig. 11. Female upper (pale form variation)

Larval hosts

The life history of *C. pyranthe* has been documented by G. A. Waterhouse (1932), Common & Waterhouse (1981), Braby (2000), and Sankowsky (2020).

The butterfly utilises several host plants in the Caesalpiniaceae (*Cassia* and *Senna* family) (Braby 2000, 2016). Nevertheless some "*Cassia*" host species are now correctly listed as *Senna* in Moss (2019, 2020). The record of this species using *Cassia brewsteri* (Manski 1960) is now considered to be erroneous, as it was a probable misidentification of *C. pomona* for *C. pyranthe* (Moss 2020) or earlier confusion between the two genera *Cassia* and *Senna* (Sankowsky 2020).

For south-eastern Queensland and northern New South Wales, the sennas include three native species: *S. aciphylla*, *S. barclayana*, and *S. sophera* (=*S. clavigera*). Records of two other exotic species, *S. alata* and *S. didymobotrya*, appear erroneous and have probably been confused by misidentification of ovipositing aged or pale female *C. pomona* (Moss 2019, 2020). I have grown the latter in my garden for the past 20 years and have never observed *C. pyranthe* ovipositing on either juvenile or older plants. Moreover, I have not observed any females of *C. pyranthe* ovipositing on plants currently classified as *Cassia* species.

Reproductive behaviour

Mating was observed when a male landed next to a freshly emerged female with fully expanded soft wings. He appeared to push the female's wings leftwards then quickly curled his abdomen towards the female's abdomen and copulation commenced. Still mated, positioned side by side for a short period, they flew a short distance and settled again, each facing the opposite direction. The full duration of copulation was not recorded.

During January 2008, a female was observed laying eggs on several cultivated *S. barclayana* plants growing in my garden at Beaudesert in south-eastern Queensland. She settled on a leaf with wings closed. The abdomen was curled onto the upperside of the leaflet and a single egg was laid. This pattern was continued several times. Eggs were also laid on fresh shoots and occasionally on the underside of mature leaflets. Females oviposit between mid-morning and late afternoon in sunny conditions. Eggs are white, being approximately 1.5 mm high × 0.6 mm wide, spindle shaped with slightly raised wide longitudinal ribs.

First instars consumed the eggshell soon after emergence and fed openly during the day and at dusk. Larvae were observed openly resting on the upperside of the host plant leaflet, along the midrib on a pad of fine silk. Small larvae, when feeding, make irregular patches on leaflets, while larger larvae feed from the leaflet edge.

During heavy rain, the smaller larvae were found below the leaflets. Larvae reached a length of 33–35 mm at maturity after completing five instars (Figs 13–17).

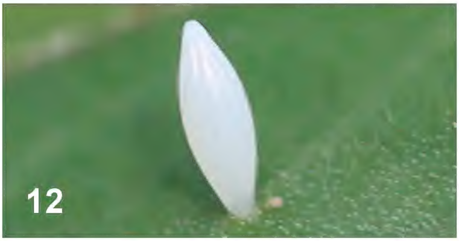

Fig. 12. Egg

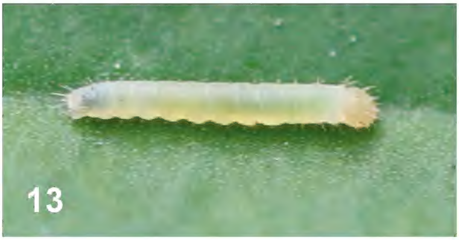

Fig. 13. Larval instar 1

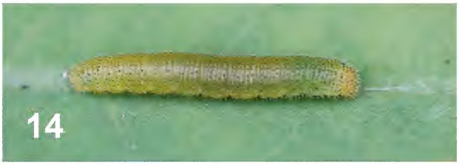

Fig. 14. Larval instar 2

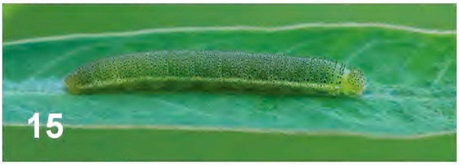

Fig. 15. Larval instar 3

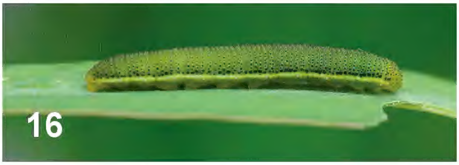

Fig. 16. Larval instar 4

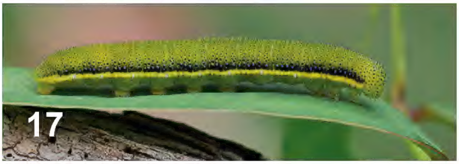

Fig. 17. Larval instar 5

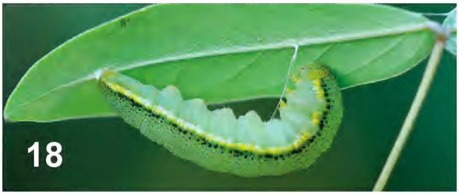

Fig. 18. Pre-pupa

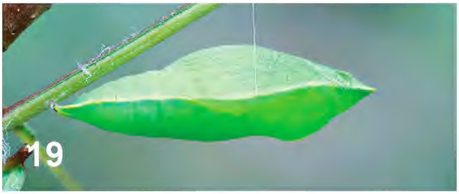

Fig. 19. Pupa lateral

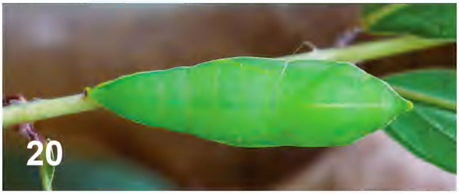

Fig. 20. Pupa dorsal

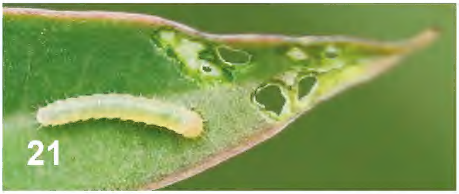

Fig. 21. Larval instar 1 feeding

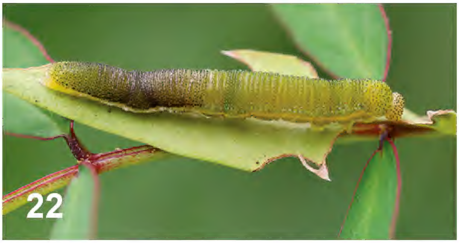

Fig. 22. Ecdysis (moulting) larva

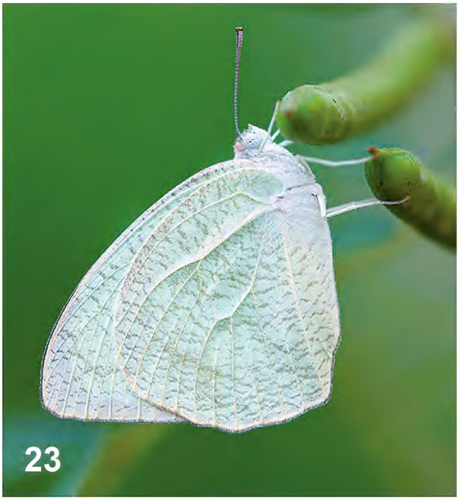

Fig. 23. Resting adult male

Pupae are green in colour and measure 26 mm in length, and are found most often below a leaflet, a leaf rachis, or green seed pod of the host plant. They are typically attached to a pad of silk by the cremaster and a central girdle as described in Braby (2000).

Adults in captivity emerged at various times during the morning. The total time from egg to adult in Beaudesert during November–December was 25 days, with egg duration 4 d, larval duration 12 d and pupal duration 9 d.

Included below are some interesting statistics on seasonal form numbers for two broods bred in Beaudesert on the host *S. barclayana* during mid-January until late March 2004. In mid-February 15 adults emerged and of these all were the dark form, and over the period of 24–27 March, 20 emerged and of these, all except one male butterfly were the pale form.

Interestingly the rainfall total I recorded at my house in Beaudesert for February 2004 was 269 mm and March 10 mm, so humidity at time of emergence may have an effect on the prevalence of forms.

Within the boundary of the Scenic Rim Regional Shire, south of Brisbane this species can be common during late summer and early autumn with adults being present throughout the year (except for July and August). Overall, it is less frequently observed during the cooler months of the year. There are perhaps two or three generations per year in this region, which likely depend on rainfall, and the subsequent availability of fresh growth. Waterhouse (1932) reported that the early stages do not survive cold conditions or frost. Edwards (1948) also reported that, near Mitchell (inland Queensland), the early stages and host *S. barclayana* did not survive winter frosts and suggested that populations re-establish each season by migrants from the eastern coast.

Acknowledgements

I thank John Moss and an anonymous reviewer for additional suggestions to the manuscript.

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Plant it and they will come

Garry Sankowsky

In December 2021, for the very first time since we have been on our property, in Tolga, we were blessed with the arrival of dozens of Five-Bar Swordtails (Figs 1, 2). At first, I thought they had just flown in but after females were seen ovipositing near the top of the tree, it was noticed that the foliage on most of the higher branches had been eaten, so some females must have visited a month or so earlier and these butterflies must have emerged in our garden. This is the only part of the plant that was producing new growth. It seems that if the ends of the branches are not stripped by larvae, no more new growth is produced for that season, so the larvae actually make the next flush come for the following brood.

The Five-Bar Swordtail (*Graphium aristeus*) is rarely observed and most butterfly enthusiasts have rarely seen it, even living in the tropics. This butterfly prefers two types of habitats, one being drier, semi-deciduous to deciduous rainforest amongst granite boulders, and in higher rainfall rainforest on the east coast, on lower sections of streams that flow from the hills or mountains to the west. One exception is the very special rainforest at Shipton's Flat, near Cooktown on the property of the Roberts family. In the dry rainforest their host plant is *Miliusa traceyi* while in the moist coastal areas, host plants are *M. brahei* and *M. horsfieldii*.

In the dry rainforests the larvae do not appear to pupate on the tree as it is deciduous. Graham Wood (Wondecla) reported finding pupae under the boulders in leaf litter on Mt White, which is on Lochinvar Station, near Coen, Cape York Peninsula. This would offer the pupae protection, as it is assumed that, like the Four-Bar Swordtail, they can skip seasons.

Lewis Roberts, from Shipton's Flat, has observed this butterfly fairly closely, as they breed most years on his property and he has passed his observations on to me. The most interesting behaviour of the females is that they mostly lay their eggs in batches, rather like the White Nymph (*Mynes geoffroyi*) does. This is the only swallowtail butterfly in Australia that does this. The small larvae are gregarious at first, then start to spread out as they get larger.

The pupae are attached very flimsily, with a girdle that breaks easily and the cremaster separates easily from the silken pad. Lewis has found pupae under the leaves of the host plant but many of over-wintering pupae will end up in the leaf litter underneath the tree. As *M. traceyi* and *M. horsfieldii* shed all their leaves each season, before flowering and flushing with new growth, pupae attached to leaves will eventually drop to the ground. Male butterflies seem to be aware of this and

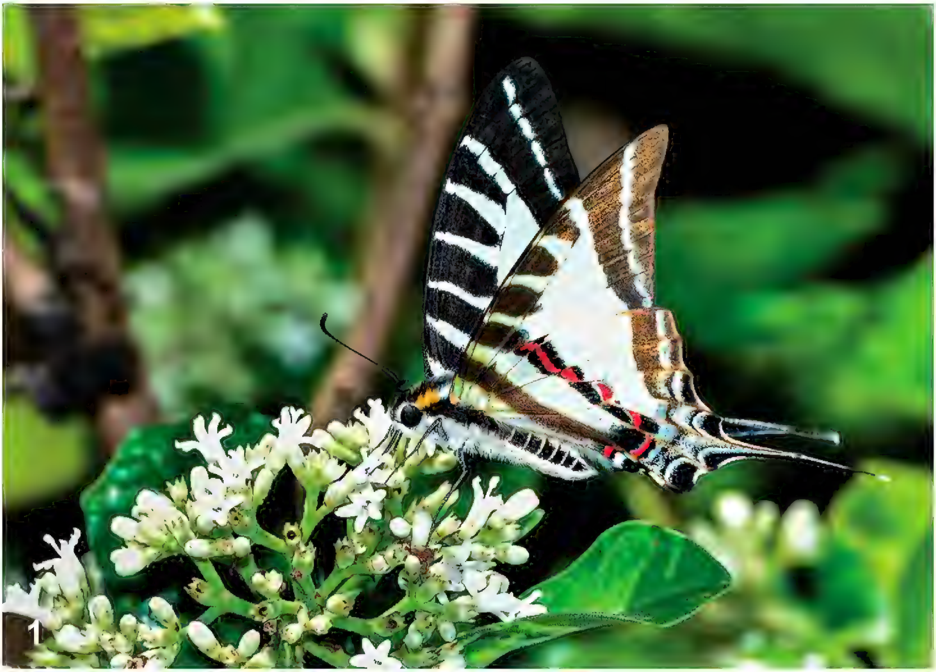


Fig. 1. Five-Bar Swordtail (*Graphium aristeus*)

therefore spend time cruising over leaf litter under the host plants, only a few centimetres from the ground, searching for freshly emerged females. They did this for over a week under our tree at Tolga and Lewis also observes this behaviour during each brood at Shipton's Flat. He has observed once only, *G. aristeus* at Shipton's flat reach such large numbers, that all the host plants in the rainforest were stripped of their leaves and thousands of larvae were crawling down the trunks, looking for more host plant. A large number of these would have ultimately perished.

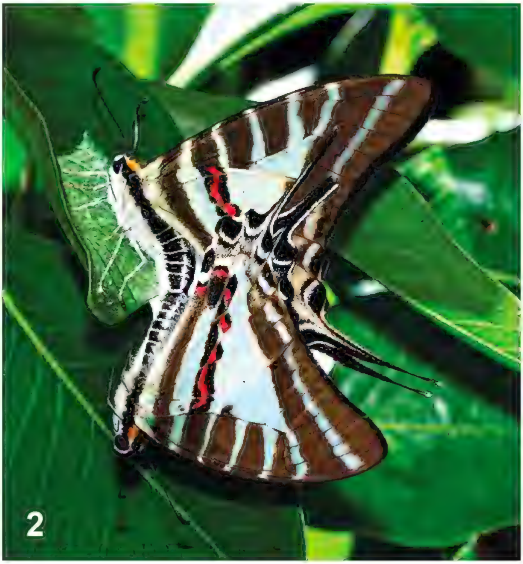


Fig. 2. Five-Bar Swordtail mating

The Five-Bars spread out on migratory flights following a good brood and can be seen feeding on nectar or mud puddling, as they refuel, before continuing on their way. They have been seen at least 200 km from known breeding sites. Most of the females never find a host plant to oviposit on but if you are lucky enough to have one growing in your garden, when they pass by, they will certainly lay eggs. The resulting adults do not usually remain but move on. Occasionally they are seen on Mt Archer, near Rockhampton, but the nearest *Miliusa* plants are about 200 km to the north of this site.

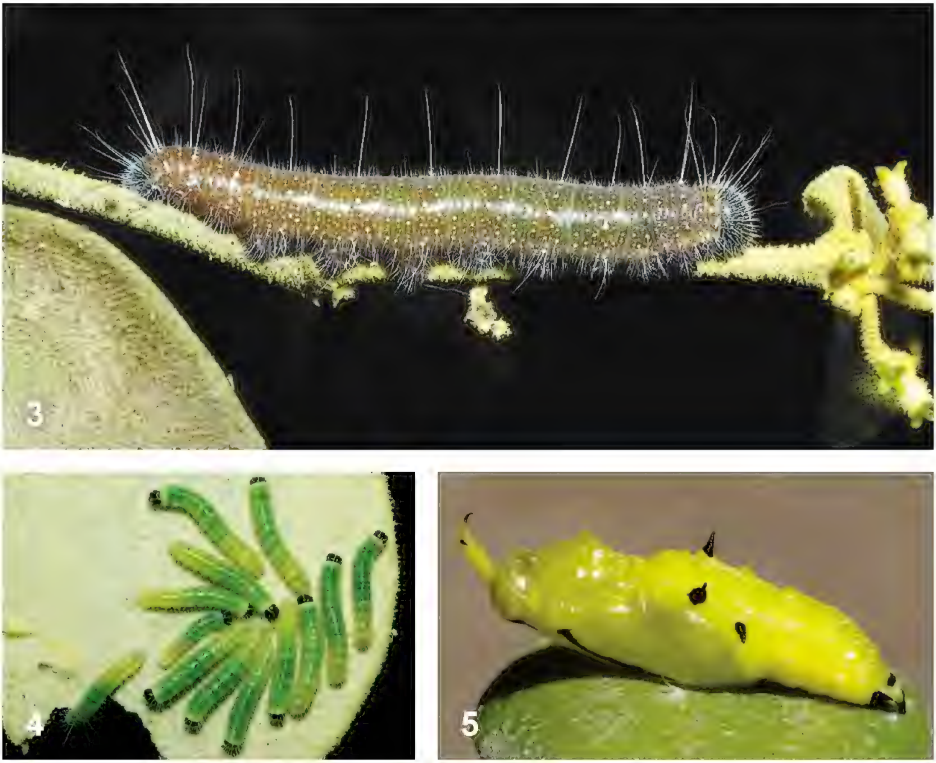
When my wife (Nada) and I moved from Mt Tamborine to Tolga in 1982, we left about 2000 plants in tubes with a friend of ours, who owned a large wholesale nursery on the mountain. These were later shipped to us in 1983, when we had established bush houses to hold them. Most of these plants were butterfly host plants, which were our primary interest at that time. Thus, we planted the first *M. traceyi* plants in 1984, and in 1985, planted the one which the *G. aristeus* females laid eggs on this season. It is on a bank just behind the house and is now about 15 m tall. This species is deciduous and in about mid-October, after the first storm, all the leaves fall and then thousands of small yellow flowers appear all along the branches. When the flowers are almost mature, a flush of soft green new growth starts. Sometime, over the next month or so, the *G. aristeus* will emerge from these dormant pupae and the first brood has a mass of fresh foliage to feed on.

When we started planting our host plants in the garden, the growth rate was extremely fast, as the soil had been cultivated with a bull dozer and covered with a heavy layer of peanut-shell mulch. Most plants took off, with a growth rate of about 2 m a year. It took only about six months for many butterflies to find them. Interestingly Ulysses butterflies (*Papilio ulysses*) oviposited on many different southern Queensland plants in the Rutaceae family, including *Acronychia, Flindersia, Melicope and Acradenia.* The larvae were quite happy to feed on these but this only happened while the plants were juvenile.

Some rainforest species are reluctant to move too far from their habitat. It took five years for *P. ambrax* to arrive, even though they breed in the Tolga Scrub, only a few km away.

Over the years, most of the butterflies that we have host plants for, have bred in the garden. The main exceptions being various Lycenidae that are associated with specific ants. A few Lycenidae that breed regularly are the Small, Large and Tailed Green Banded Blues, as well as the Shining Pencilled Blue. The latter, though small, has a shimmering blue male, that certainly catches one's eye. One exciting arrival was (Figs 3–5) Yellow-banded Jezebel (*Delias ennia*) in 2016.

These are usually seen in the garden each year but the specific host plant *Notothixos leiophyllus* (Goldenleaf Mistletoe) was not in the garden. A plant established itself on a *Melicope rubra* and the larvae that year completely defoliated it. Since then, we have seen fresh specimens regularly but the mistletoe must be high up in the trees and out of sight.

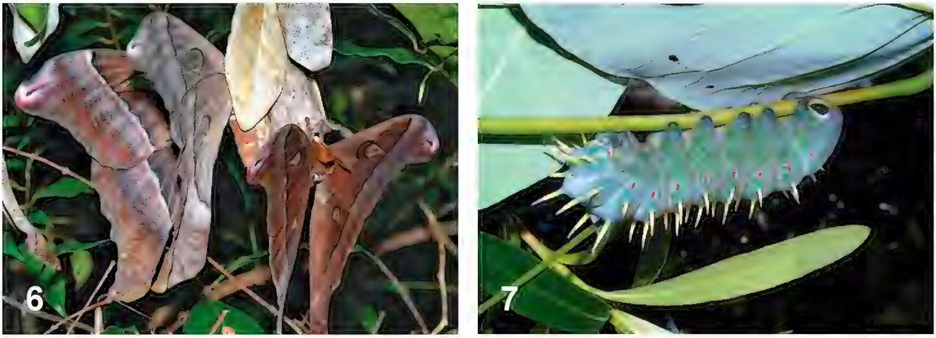


Figs 3–5. Yellow-banded Jezebel (*Delias ennia*)

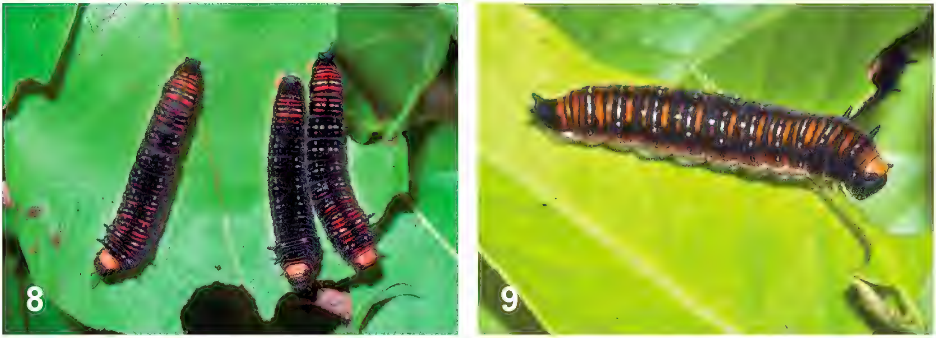
Another exciting arrival was the Hercules Moth (*Coscinocera hercules*) (Figs 6,7) in 2004. Since then, they have appeared from time to time and have several host plants, including all *Flindersia* spp, all *Glochidion* spp, all *Polyscias* spp, *Petraeovitex multiflora* (a large vine from Cape York) and *Homalanthus novoguineensis*. In addition, large numbers bred on the *Petraeovitex* vine.

So, it seems that if you plant the correct host plants the butterflies will likely find them, provided of course you live within a reasonable distance from where they naturally occur, which can be up to 200 km away. If you have a rainforest garden the number of open forest species will be limited and the reverse is also true.

For example, we now do not get Caper Whites or Chequered Swallowtails breeding in the garden, even though large migrations pass by from time to time, just outside our fence.



Figs 6,7. Hercules Moth (*Coscinocera hercules*)



Figs 8,9. Five-Bar Swordtail larvae

Finger limes and the invertebrate-friendly garden

Annette Dexter

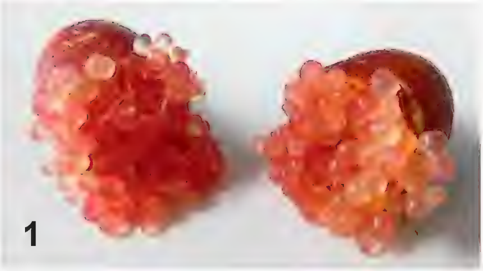


Fig. 1. Finger lime fruit. The juice vesicles are not bound to each other, unlike in domestic citrus, and can burst out under pressure after cutting, or even on the tree as the fruit ripen

Finger lime (*Citrus australasica*) is a rainforest understorey bush native to coastal areas of southern Queensland and northern New South Wales. It is one of a small group of native citrus species that includes Mount White lime (*C. garrawayi*, Cape York Peninsula), Russell River lime (*C. inodora*, northern Queensland), Dooja or round lime (*C. australis*, Queensland) and desert lime (*C. glauca*, inland Australia). The "caviar lime" fruit (Fig. 1) has become popular as a gourmet indigenous food, and plants for home gardeners are now readily available in nurseries or through specialist online retailers. There is a range of varieties, usually grafted onto another finger lime rootstock, with different shape, colour, flavour and fruiting season, including at least one ('Judy's Everbearing') that fruits year-round.

While many gardeners plant finger lime bushes to obtain fruit, additional enjoyment can come from having butterflies reproduce on the bush, such as the Orchard Swallowtail butterfly *Papilio aegeus* (Fig. 2) and the Dainty Swallowtail butterfly *P. anactus* (Fig. 3). I first planted a finger lime with these parallel goals in mind four years ago, while transitioning my Salisbury, Brisbane, garden from an only modestly successful vegetable patch to a collection of local natives. Other plantings, chosen primarily as butterfly and moth host plants, include emu foot (*Cullen tenax*) for the Chequered Swallowtail and several line blue butterflies, orange-petalled passion flower (*Passiflora aurantia*) for the Glasswing butterfly, burny vine (*Trophis scandens*) for the Purple Crow butterfly, corky milk vine (*Secamone elliptica*) for the Common Crow and Blue Tiger butterflies, zigzag vine (*Uvaria leichhardtii*) for the Pale Triangle butterfly, love flower (*Pseuderanthemum variabile*) for the Australian Leafwing butterfly, *Aristolochia meridionalis* for the Clearwing Swallowtail, mangrove wax flower (*Vincetoxicum carnosum*) for the Swamp Tiger, Blue Tiger and Lesser Wanderer butterflies, slender grape (*Causonis clematidea*) for Joseph's Coat Moth and several hawk moths, scrambling caper (*Capparis sarmentosa*) for the Caper White and Caper Gull butterflies, monkey rope vine (*Parsonsia straminea*) for the Common Crow butterfly, butterfly bush (*Pavetta australiensis*) for Gardenia Bee Hawk Moth, Ceylon leadwort (*Plumbago zeylanica*) for the Zebra Blue butterfly and karamat (*Hygrophila angustifolia*) for several other butterflies. Most of these plants have since been used as hosts by the desired species, and some are visited regularly. Orchard Swallowtails and to a lesser extent Dainty Swallowtails certainly do visit my finger limes, though the local populations are probably maintained more on plantings of domestic citrus around my suburb.

However, finger limes can support more invertebrates than just butterflies, something I first discovered on inspection of my bush to see if fruit was setting. Increasingly, observation of other species has become a fascination as well as an opportunity to develop my photography skills. Some of the species I have observed are reported here, grouped by the ways they use the bush, either for food or by making use of its thorny structure.

Leaf feeders

A small number of insect species feed directly on the leaves of the finger lime. Leaves can be a rich source of protein for growing bodies. However, insects usually require adaptations to be able to use the leaves of a given plant. This can be due to chemicals produced by the plant in defence, for example antifeedants that deter feeding or toxins that kill early life stages. Mature leaves can also be tough, so insects oviposit on soft young growth that early life stages can more readily feed on.

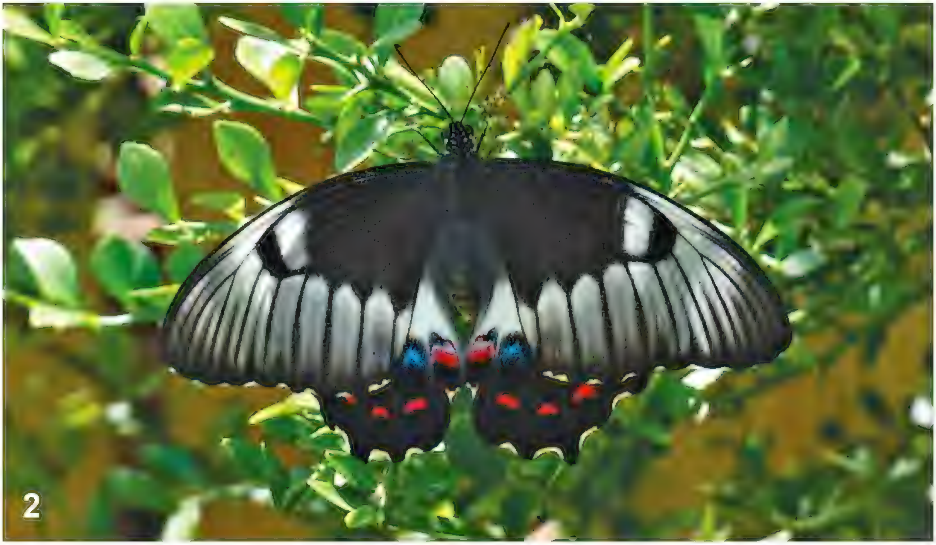


Fig. 2. Orchard Swallowtail adult female, *Papilio aegeus*

Caterpillars of the Orchard (Fig. 4) and Dainty Swallowtails (Fig. 5) are the most visible leaf feeders on finger lime. Early Orchard Swallowtail larval instars are brown and white, transitioning to a well-camouflaged green in the final instar before pupation, while Dainty Swallowtails show dark patterning through the life cycle. Interestingly, the structure of finger lime leaves is barely changed on passage through the gut (Fig. 6): crushed orchard swallowtail frass still comprises recognisable green pieces of leaf. Nutritional value for the caterpillars may be obtained simply by absorbing protein- and sugar-rich fluid present within the leaves, without otherwise digesting the fibrous leaf structure.

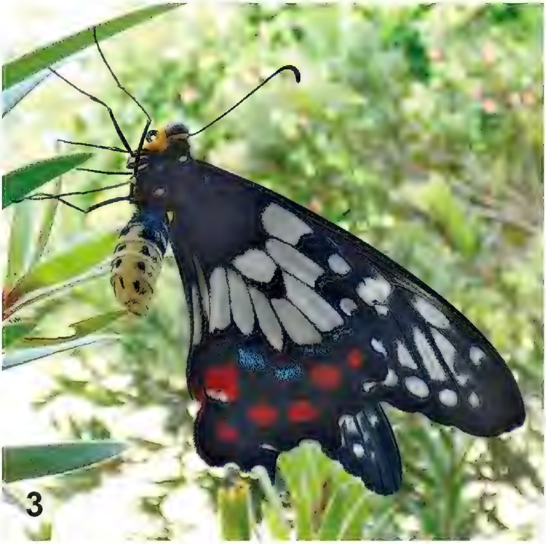


Fig. 3. Dainty Swallowtail adult, *Papilio anactus*

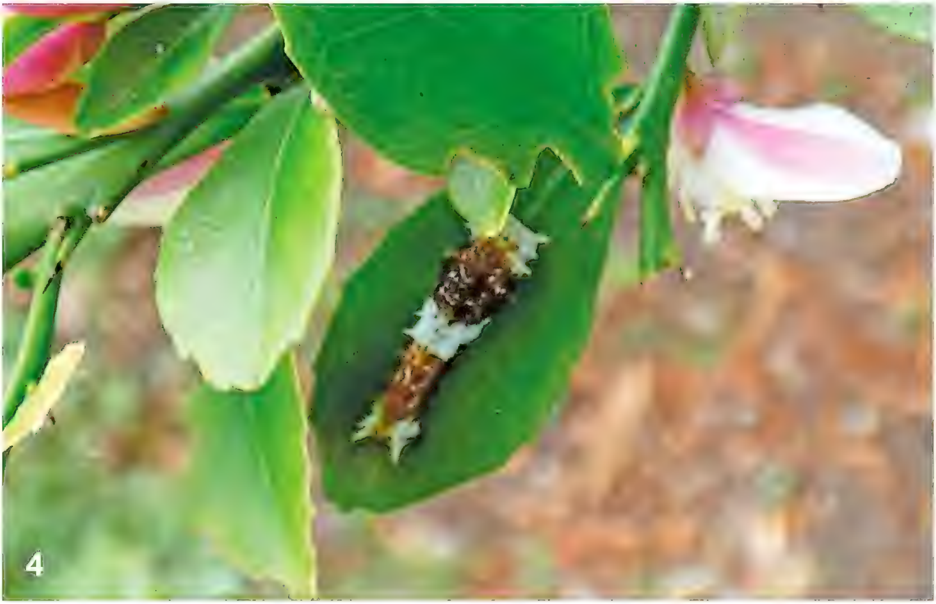


Fig. 4. Orchard Swallowtail larva

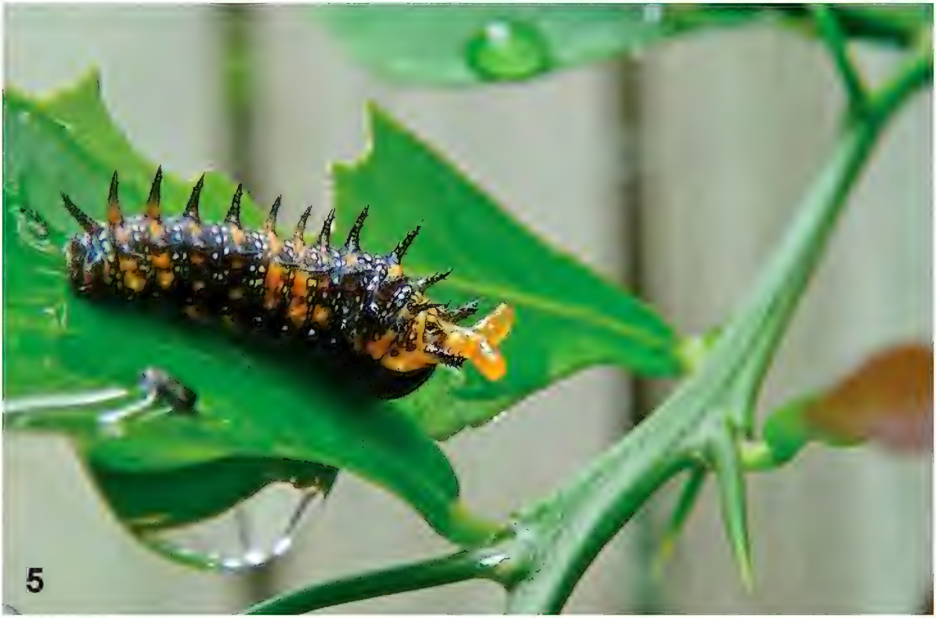


Fig. 5. Dainty Swallowtail larva

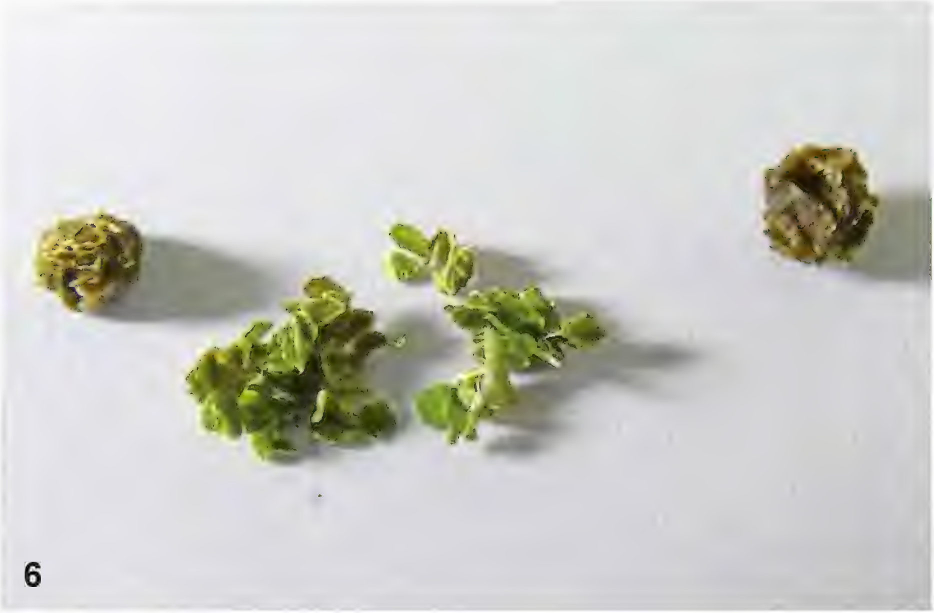


Fig. 6. Frass (whole and crushed) from a late-instar Orchard Swallowtail larva

Grasshoppers are another class of leaf-feeder feeding on finger limes, with the native giant grasshopper *Valanga irregularis* (Fig. 7) feeding on new growth, sometimes nipping completely through young shoots, or even eating small fruit.

Flower feeders

As would be expected, flowers of the finger lime attract insects that feed on nectar or pollen, such as the introduced European honeybee and several native bee species (Fig. 8). Nectar provides energy in the form of sugars, while pollen is a source of protein that can be collected and taken back to solitary or communal nests for growth of the next generation.

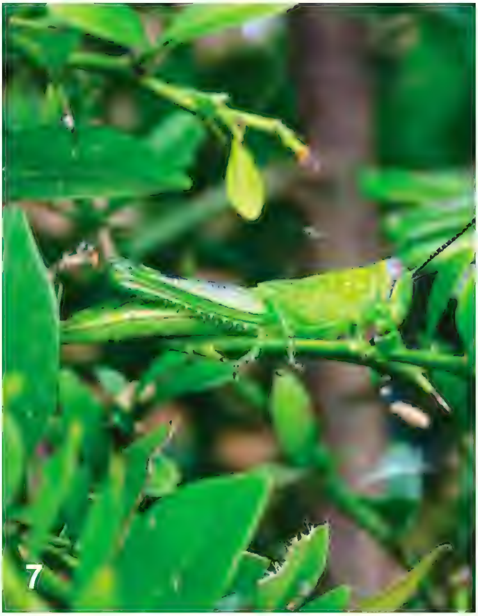


Fig. 7. Giant grasshopper, *Valanga irregularis*

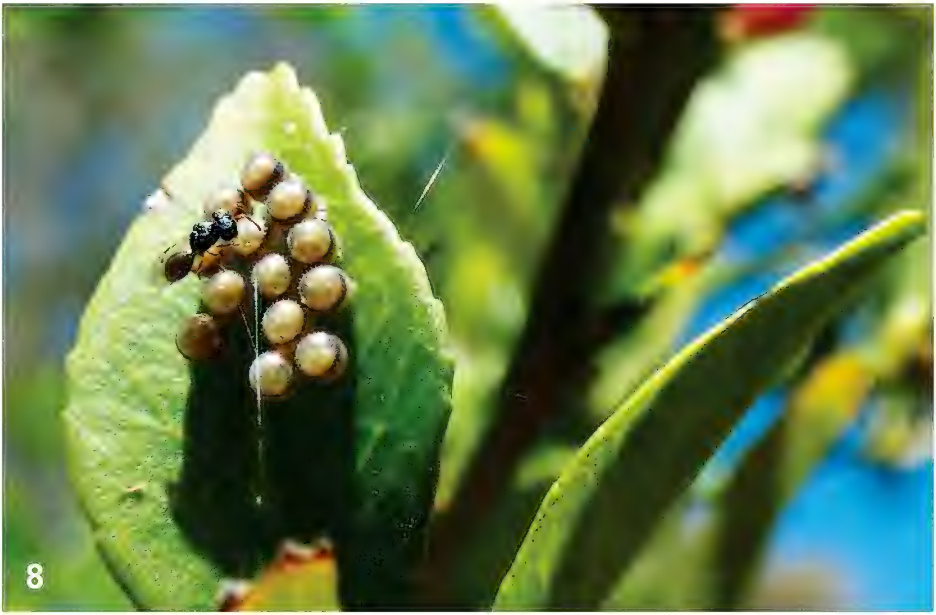


Fig. 8. A native stingless bee (*Tetragonula carbonaria*) on what may be assassin bug eggs

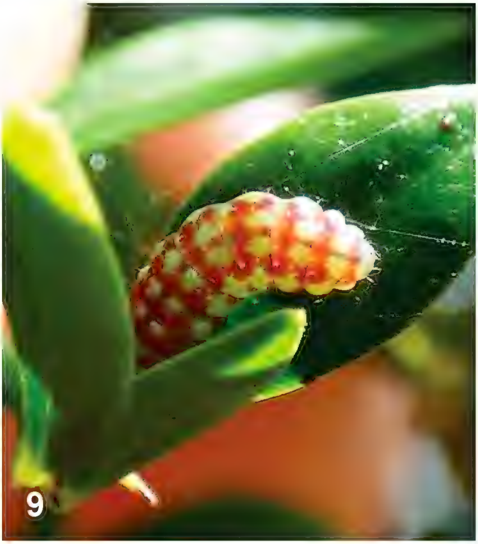


Fig. 9. Flower-feeding larva

I have also observed small pink and white caterpillars (Fig. 9) that seem to feed on finger lime petals. Petals may represent a softer edible structure as well as one less defended by deterrent chemicals, allowing this to be a viable food for the caterpillars when leaves are not. On reaching full size, these caterpillars spin a protective web on a single leaf and pupate in this structure. I did not raise any of the larvae to confirm but suspect they were a moth (possibly genus *Prays*) seen on the bush in large numbers in the same period (Fig. 10). As a gardener, I was concerned that these caterpillars might prevent fruiting, but this turned out not to be the case: I have had an ample crop despite the moths visiting on one fruiting cycle. It is hard to judge whether larvae feeding on petals prevented fruit set, as a significant fraction of finger lime flowers do not set fruit in any case, but in a few cases, it appears that fruit did develop from flowers where the petals had been consumed.

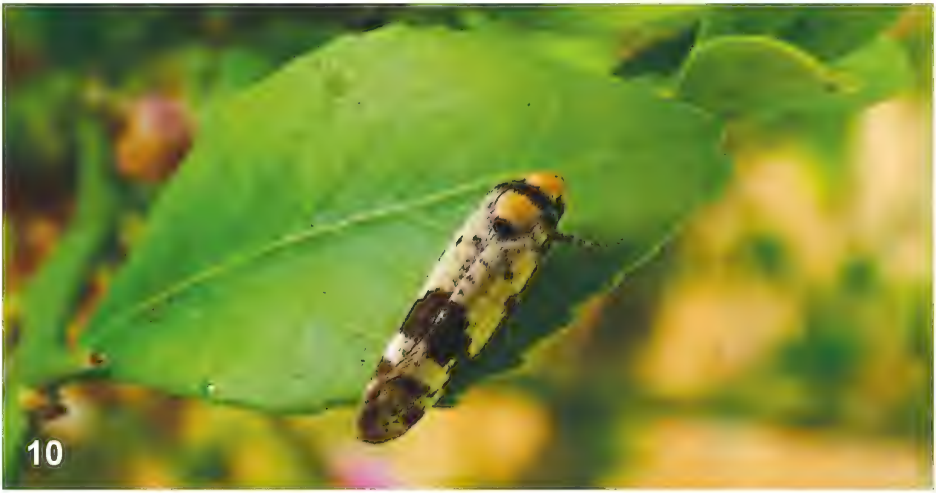


Fig. 10. Presumed adult moth of flower-feeding larva, genus *Prays*

Sap feeders

Additionally, some invertebrates feed on finger lime sap. For species with suitable (i.e., piercing) mouth parts, sap feeding may offer the advantage of avoiding any deterrent compounds concentrated in leaves. The most visible sap feeder on my finger lime was the Bronze Orange Bug, *Musgraveia sulciventris* (Fig. 11).

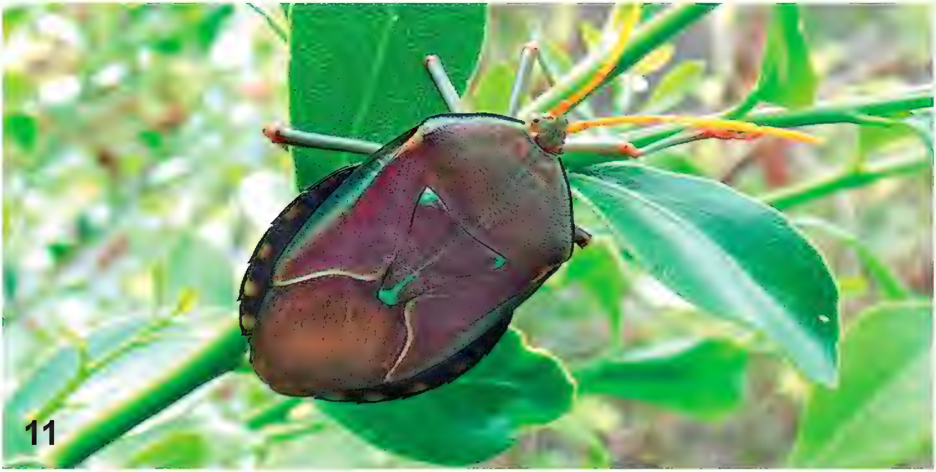


Fig. 11. Bronze orange bug, *Musgraveia sulciventris*

Up to four of these large insects could be present at one time, often as mating pairs. This bug is thought to contribute to fruit drop in domestic citrus, but did not prevent ample fruiting on my finger lime. Other sap feeders included the Green and Black Planthopper, *Desudaba psittacus* (Fig. 12), and species of soft scale (Fig. 13). Scale insects, like sap-feeding aphids, are often attended by ants that may defend them against predators. As a food source, sap is rich in sugars but may contain inadequate protein, leading insects to consume large volumes of sap and secrete the excess sugar in a syrup

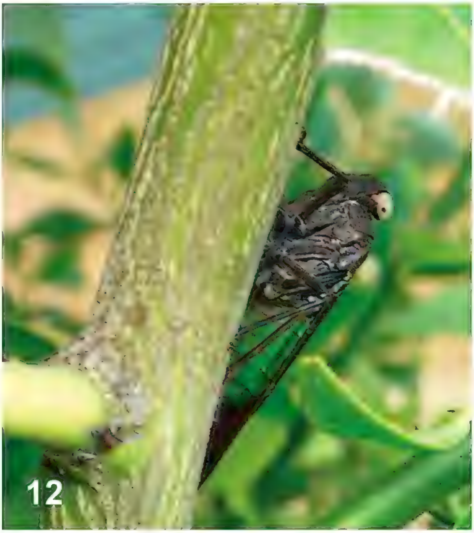


Fig. 12. Green and black planthopper, *Desudaba psittacus*

collected by ants. Sugar secretions such as these often promote the growth of black sooty mould on leaves, something that can be managed by pruning the affected section of the bush. However, even though I did not prune the bush this year, I found the area occupied by scale remained small, possibly due to adequate numbers of insect predators.

Cicadas are another group of sap feeders, although the nymphs feed underground from roots rather than from shoots. The cicada casing (Fig. 14) may have come from a cicada that fed underground from finger lime roots for an extended time before emerging to reproduce and then die within several weeks.

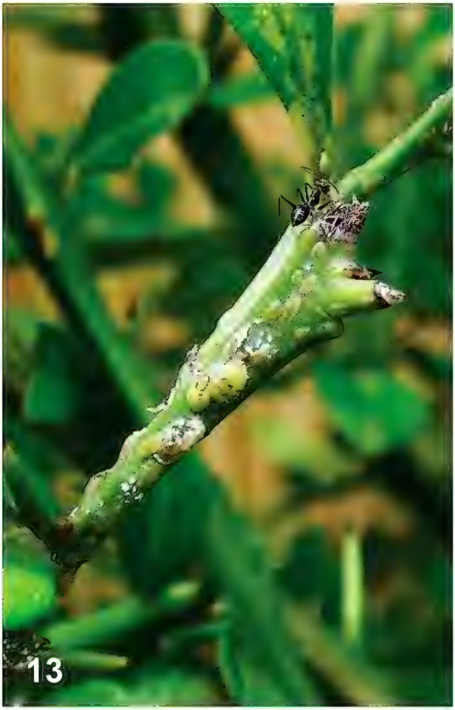


Fig. 13. Soft scale with ant in attendance

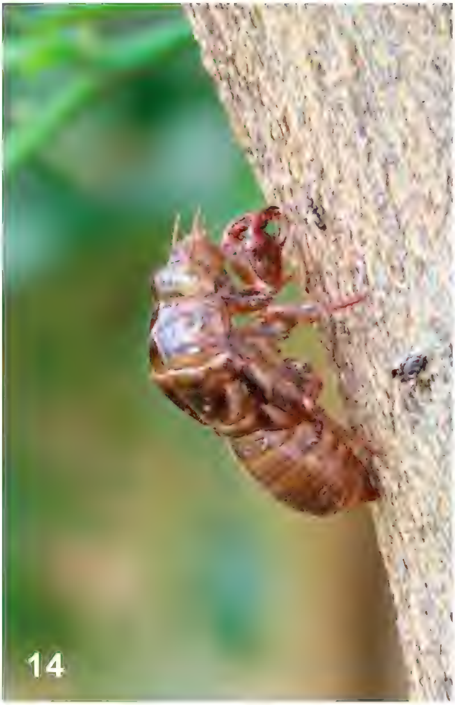


Fig. 14. Cicada shell, unknown species

Predators and shelter-seekers

Finger limes have a generally thorny structure, which may make them a good refuge for invertebrates to shelter in from birds or other large predators. Various species of fly and moth could be seen resting on the structure, and grasshoppers and spiders tended to use the bush as a safe space to moult and allow their new exoskeleton to harden. These shed exoskeletons were often observed on the bush.

Unfortunately, for invertebrate prey, invertebrate predators can also find the lime bushes attractive places to hide. For example, Assassin Bugs (Fig. 15) prey on caterpillars that can be many times their own size and they use the lime bush to lay their eggs on (Fig. 8). In addition, my lime bush was a preferred hunting spot for a praying prantis, shown feeding on a captured fly (Fig. 16).

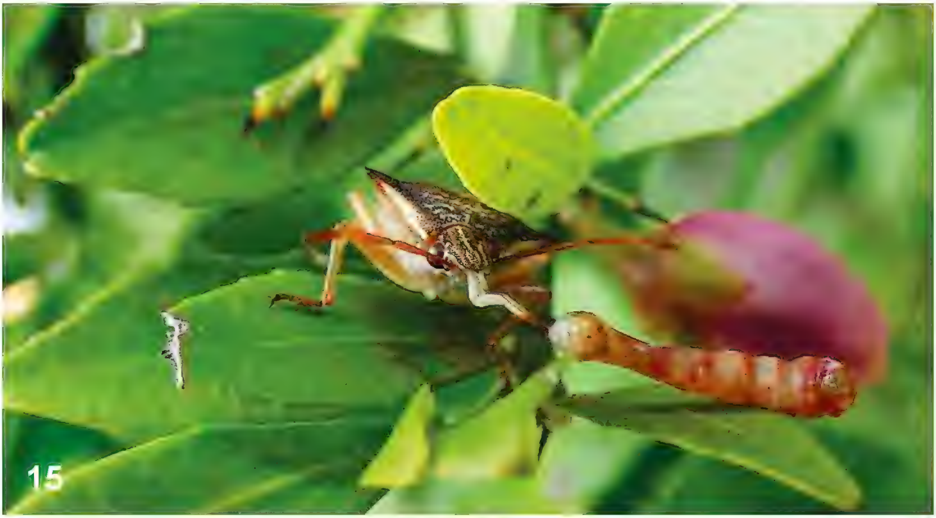


Fig. 15. Assassin bug feeding on moth caterpillar (same caterpillar species as in Fig. 9)

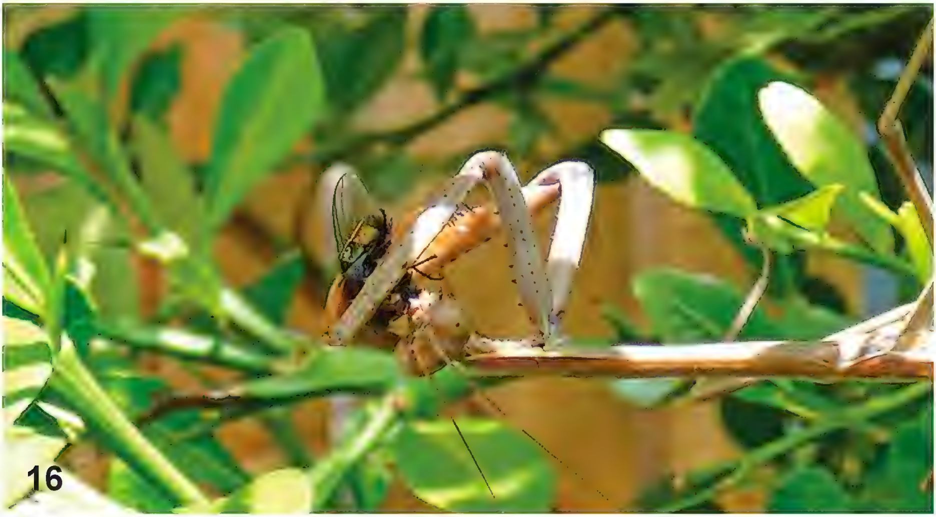


Fig. 16. Praying mantis feeding on a fly

Small spiders use finger limes as a sheltered spot to lay their eggs (Fig. 17), and larger spiders build webs outward from the bush as a structural support. Ladybirds and lacewings (Fig. 18) were seen frequently and are predators that may have helped to limit the numbers of soft scale insects.

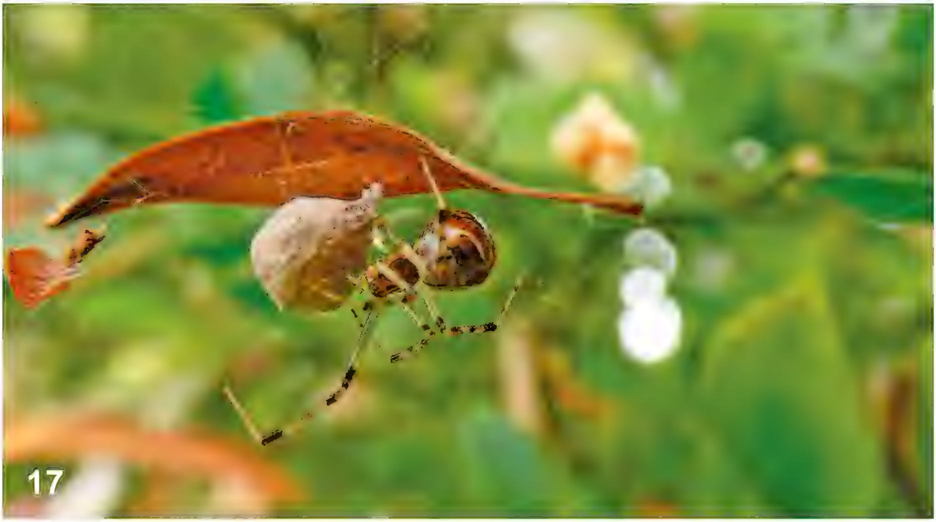


Fig. 17. Spider tending an egg sac

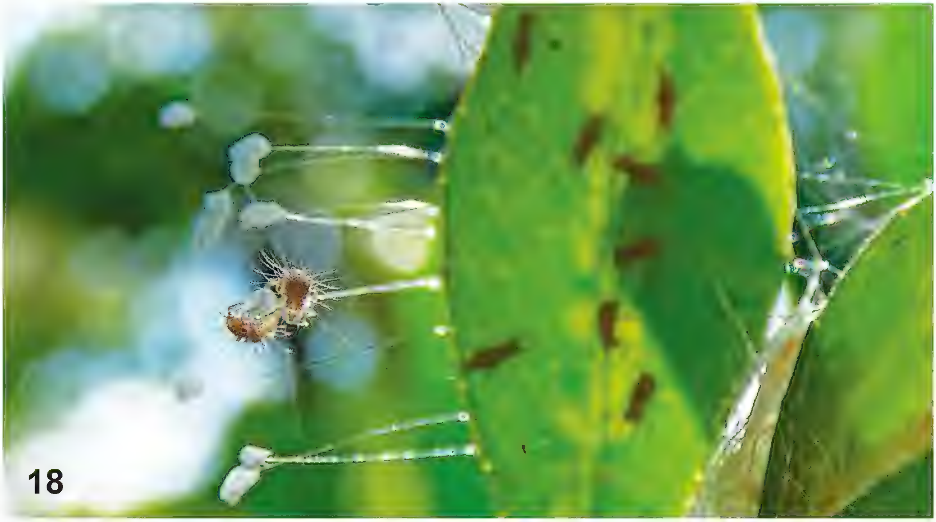


Fig. 18. Recently hatched lacewings, perhaps attempting to prey on each other as a first meal

Finger limes have proved to support a rich variety of invertebrate species, as well as providing an ongoing source of learning for me. Interestingly, the Mount White lime (*C. garrawayi*) in my garden, a native species but not local to southern Queensland, is visited by far fewer invertebrates than the four finger limes I now have, even though it is a larger bush. It is not clear whether this relates to a non-thorny structure providing less shelter or reflects the fact that this bush is not part of the regional ecosystem and does not have a long coevolutionary history with local invertebrates. I will continue observing differences between these species and may possibly replace the Mount White Lime with a local native better suited to support invertebrate biodiversity.

Acknowledgements

Many thanks to Helen Schwenke, Greg Tasney, Frank Jordan, Mark Korner and others who have helped open my eyes to the world of butterflies and invertebrates in general or provided host plants for my garden. Also, thanks to those iNaturalist volunteers who have suggested ID for species I would not have known to recognise on my own.

Observations of native wasps

Jenny Thynne

Introduction

Wasps have been feared and vilified throughout history, but they really deserve to be appreciated. In wanderings around my garden in Sunnybank, Brisbane, I've been fortunate enough to see an amazing diversity of beautiful wasps, from almost microscopic to quite large in size, belonging to a number of different families. I've been buzzed numerous times by the larger ones when I get up close and personal to photograph them, but have never been stung.

We have wasps building nests in bee hotels, making nests out of resin on the mortar between our house bricks, digging nests in the ground and in soil in plant pots, and parasitising bee and other wasp nests.

Wasps, along with ants, bees and sawflies, belong to the Order Hymenoptera, and, except for sawflies, to the Suborder Apocrita, members of which have distinct "waists". Most wasp larvae are carnivorous. The adults provide food for them by capturing prey or by laying an egg in, or on, or near the food source, usually the egg, larva or pupa of another insect.

Some tiny parasitic wasps are used as biological control agents. They are bred in laboratories and then dispersed among crops, hence avoiding the use of harmful chemicals.

There are more than 15,000 wasp species in Australia, the great majority being solitary. I've chosen members of two flower wasp families, Thynnidae and Scoliidae, and spider wasps (Family Pompilidae) to talk about.

Flower wasps

Flower wasps range in size from 2.5 mm to 30 mm. They can be excellent pollinators as they fly from flower to flower. The ovipositor (egg-laying organ) in female wasps is modified into a stinger. Although female flower wasps have a well-developed stinger, they are not aggressive.

Thynnidae family

Most species in this family have winged males and wingless females, with mating usually occurring in flight. They stay joined together for a prolonged period and feed mainly on nectar. What is particularly fascinating about these wasps is that the male brings the female along to flowers while they are joined together, and on occasions will actually bend over and feed her nectar he's gathered. He either regurgitates it, or the female collects it from a droplet held in a fringed part of the head. The female burrows in the soil with specially modified legs to locate the host on which she lays her egg; usually the larvae of beetles (Order Coleoptera).

One of the most spectacular wasp visitors we've had is a species in the genus *Zaspilothynnus (*Subfamily Thynninae*)*. I first saw a large black and red male in 2014. I didn't see any more of them for some time, but in 2017 I noticed something large flying around and then some activity on the ground. On closer inspection I was amazed to see mating wasps of this species (Fig. 1). I'd never seen the spectacular female before with her yellow and black stripes (Fig. 2). Both were about 20 mm long. Since then, I see these beauties every season, and once witnessed a male flying around with a female attached, landing on *Leptospermum flavescens* flowers and crawling around sipping nectar. Then I noticed that every now and then he was bending over and feeding the female with the nectar he'd collected (Fig. 3).

We've had several other members of the Sub-family Thynninae visit the garden, including some *Agriomyra* spp. These are much smaller than the *Zaspilothynnus,* but have beautiful markings. I see a few of them when our *L. flavescens* is in flower in spring, nearly always with the female attached to the male (Fig. 4).

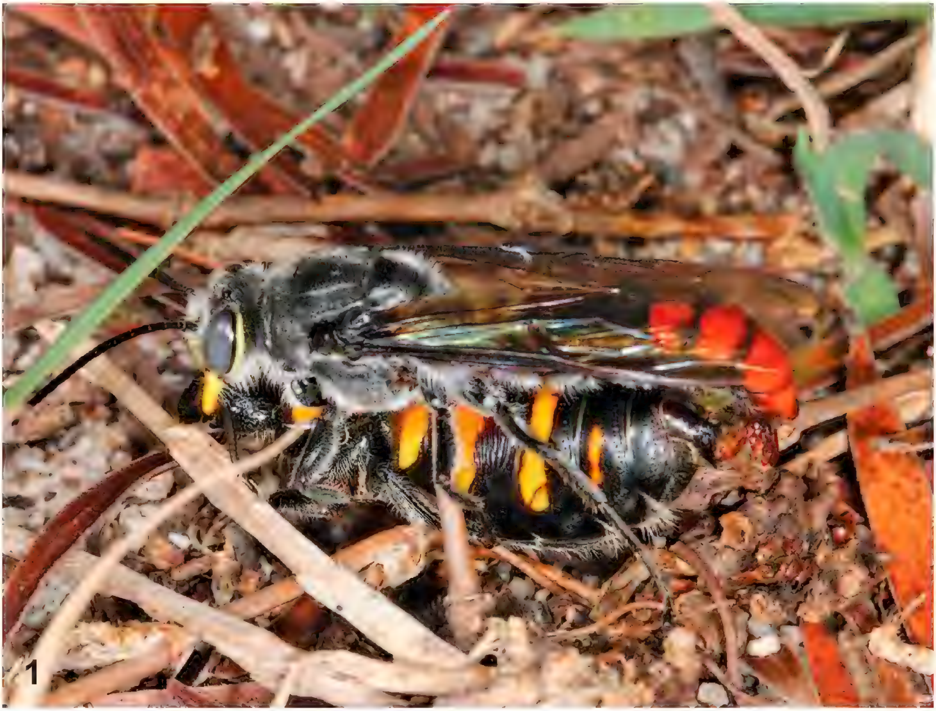


Fig. 1. Mating *Zaspilothynnus* sp.

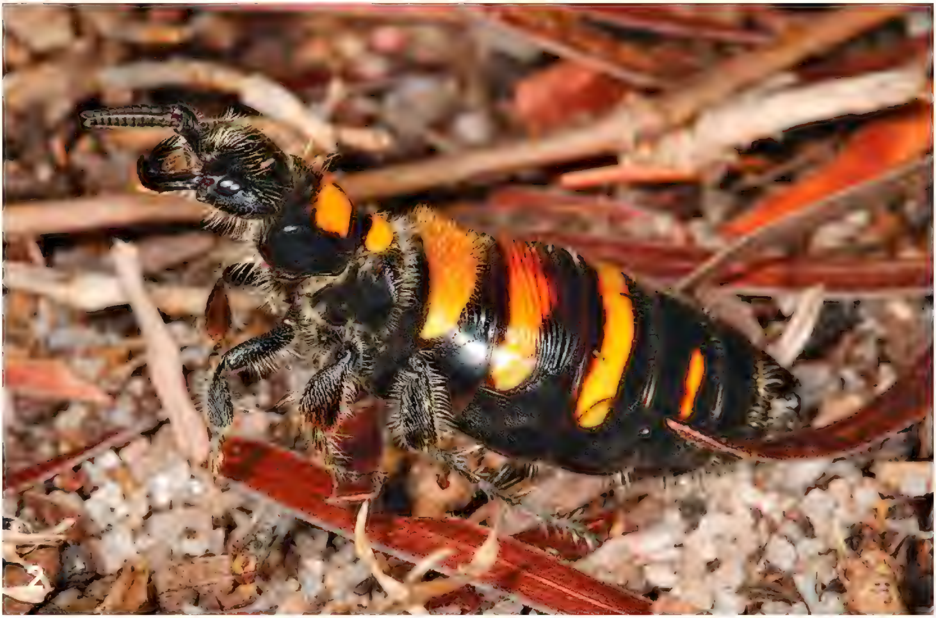


Fig. 2. Female *Zaspilothynnus* sp.

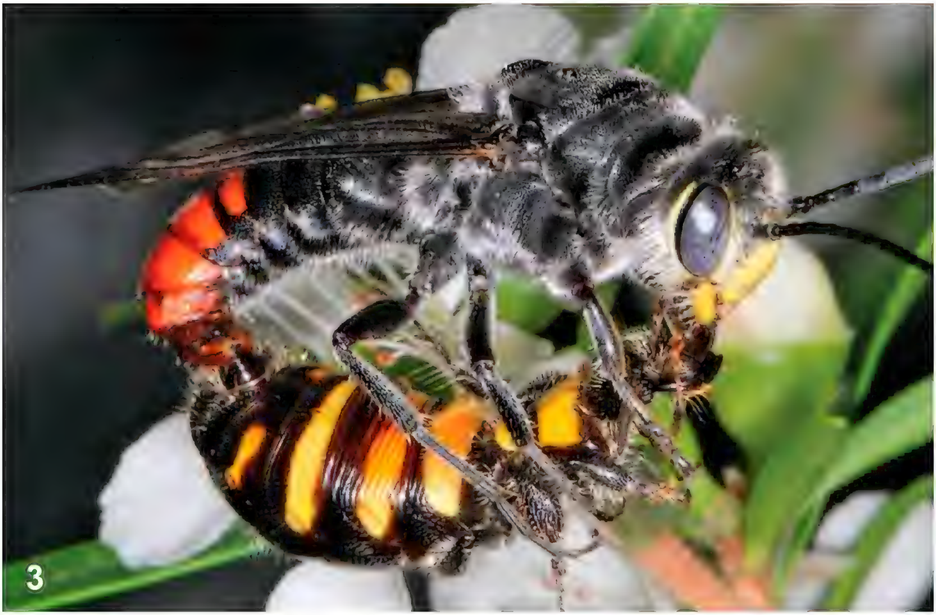


Fig. 3. Male *Zaspilothynnus* sp. feeding female on *Leptospermum flavescens*

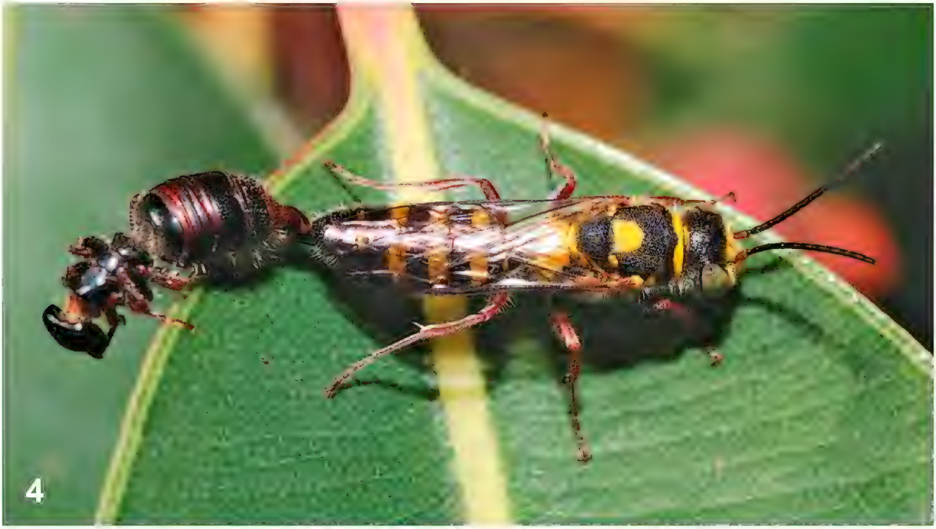


Fig. 4. Male and female *Agriomyra* sp.

Scoliidae family

Wasps in this family are often very hairy, and, unlike the Thynnidae, both sexes have wings. Females dig into soil or wood to find beetle larvae, especially Scarabiidae, upon which they lay their eggs.

Last year I saw two male yellow hairy flower wasps (*Radumeris tasmaniensis*) chasing a female which was feeding on our perennial statice flowers (*Limonium perezii*). Eventually one of the males mated with the female on a nearby leaf (Fig. 5). The females are larger than the males, up to 30 mm, with darker orange stripes. This is one of my favourite wasp species, and we get quite a few of them in the garden, sharing the flowers with the bees.

Another handsome hairy flower wasp is *Scolia* (*Discolia*) *verticalis* (Blue Flower Wasp) with its distinctive bright yellow head markings (Fig. 6). These are large wasps – about 30 mm. We've had one female using the soil in a plant pot as a nesting site. It's wonderful to see this wasp flying around in the sun, as it has beautiful iridescent blue wings.

Some plants for attracting flower wasps

The plants I most commonly see flower wasps visiting include *Leptospermum* spp., *Melaleuca* spp., perennial basil (*Ocimum gratissimum*), *Grewia occidentalis*, perennial statice (*Limonium perezii*), purpletop verbena (*Verbena bonariensis*) and oak leaf geranium flowers (*Pelargonium quercifolium*).

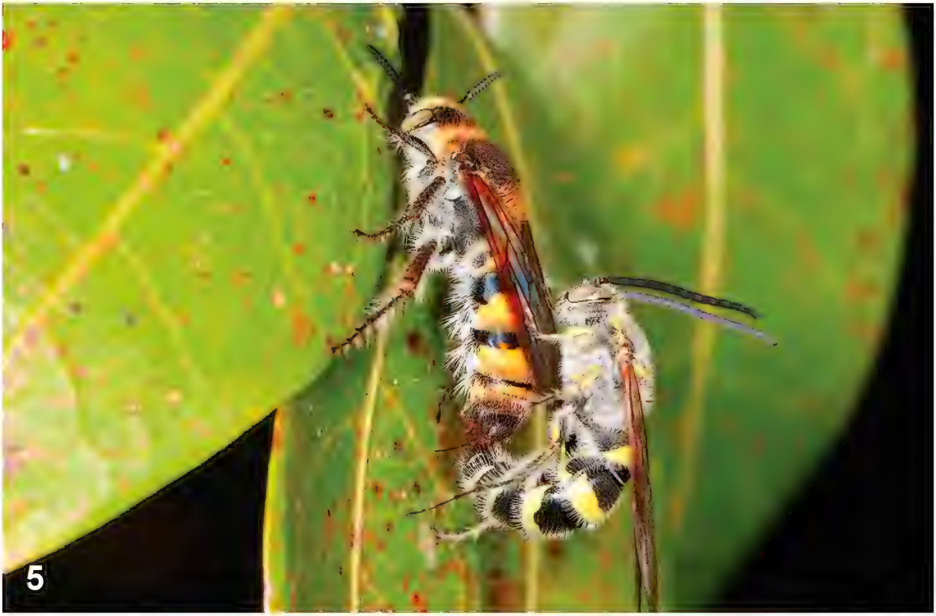


Fig. 5. *Radumeris tasmaniensis* mating

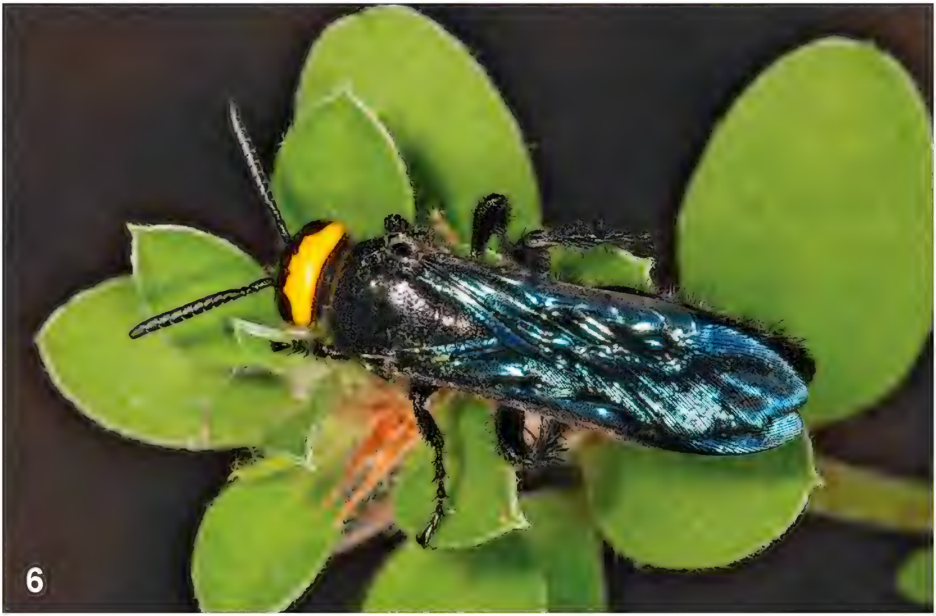


Fig. 6. *Scolia* (*Discolia*) *verticalis*

Spider wasps

The larvae of one wasp family, Pompilidae, eat only spiders or the larvae of other spider wasps. The female spider wasps lay their eggs in or near the host, usually one egg per spider, and the larvae feed on it when they hatch. Wasps in this family vary in size from 3.5.mm to 35 mm, and females which burrow in sandy soil such as we have in our yard have long spines on their front foot (tarsus) for raking and digging.

One day when I was gardening, I noticed a large and very still female tent spider (*Cyrtophora moluccensis*) on the ground. A female orange spider wasp (*Cyptocheilus* sp. about 30 mm long) suddenly appeared with characteristic wing flicking, and dragged the spider across the grass for about a metre. (Fig. 7). She had obviously paralysed the spider with her venom. She then hopped another 60 cm to her nest hole. I wondered how she would ever fit this large spider into the small hole. She looked down into the hole, came back and looked at the spider, then went back to the nest hole and started digging out some dirt. She repeated these actions about seven times, then dragged the spider over to the nest, eventually pulling it down into the hole. (Fig. 8). It was a tight fit, but she did it. Eventually she squeezed herself out from under the spider. I checked later on and she'd covered the nest hole. It was fascinating to watch this process.

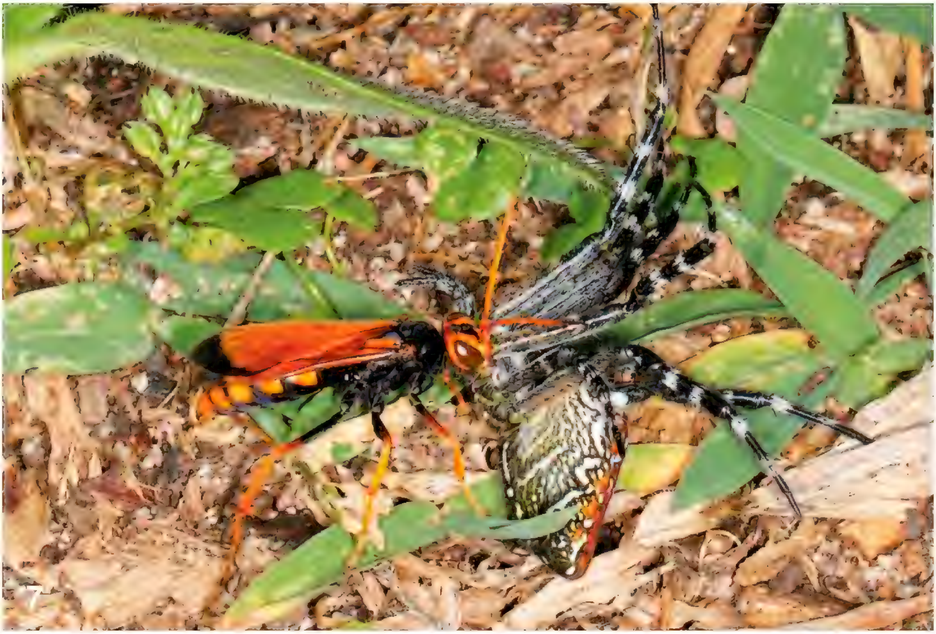


Fig. 7. Female spider wasp (*Cryptocheilus* sp.) dragging spider to nest hole

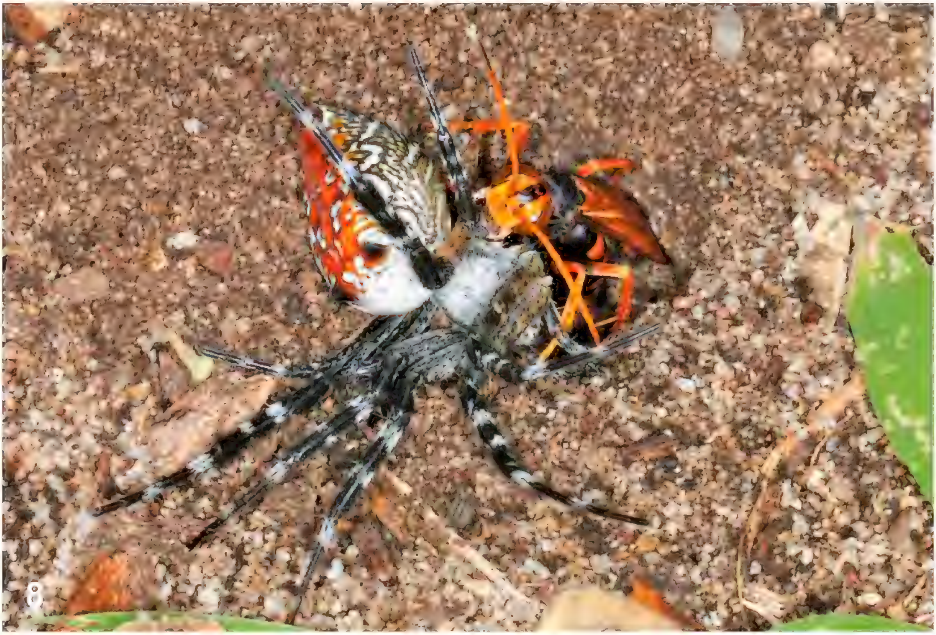


Fig. 8. Female spider wasp (*Cryptocheilus* sp.) pulling spider down into nest hole

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Some variability in *Papilio fuscus capaneus* Westwood, 1843 (Lepidoptera: Papilionidae: Papilioninae) from Brisbane

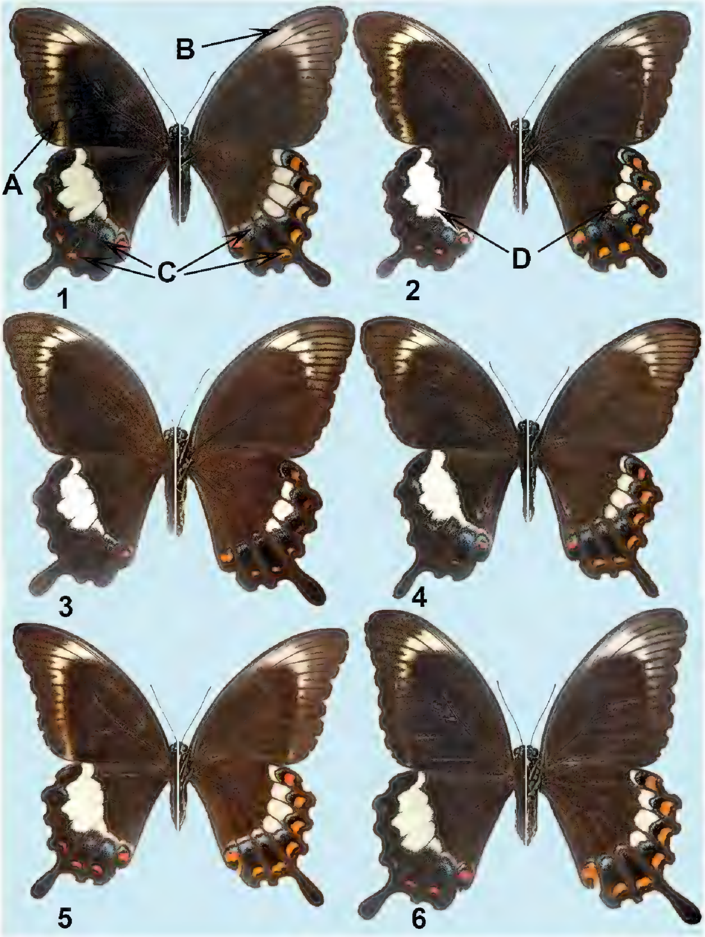
Trevor A. Lambkin

Papilio fuscus capaneus Westwood, 1843, the Fuscous Swallowtail butterfly is a large showy species that is a common visitor to Brisbane gardens as its larvae feed on the fresh growth of cultivated citrus plants. In some years it is considered a rarity, but this summer in Brisbane it has been abundant due to the very good wet season experienced in southeastern Queensland. Thus, at my home in Taringa, Brisbane, *P. f. capaneus* butterflies have been regularly visiting my potted citrus trees. In fact, this summer, there has been no time that larvae have not been present on the plants.

The butterfly is predominantly an east coast species, occurring from Cape York Peninsula, across to the west coast of the peninsula, and down the east coast to northern New South Wales (Braby 2016). It naturally occurs in dry vine thicket and monsoon forests, but the butterfly does venture into suburbia. Sankowsky (2020) lists and illustrates several native hostplants that are found in these scrubs. This species is well known for its ability to enter pupal diapause which can often last for over 12 months and sometimes more than three years.

Due to variability in markings of the butterflies in the tropics, Braby (2000) commented that individuals from Cape York were variable in their markings and were thus difficult to distinguish from individuals of *P. f. indicatus* Butler, 1876 from further north in Torres Strait. Having so many *P. f. capaneus* breeding in my garden this year has allowed me to collect a range of specimens and compare them to determine the variability within individuals in this part of the world, reared from the same plants over the same summer of 2021/2022. Therefore, illustrated here are six of these specimens reared from Brisbane, to illustrate the variability of markings that exist in both sexes from one location; predominantly, the extent and colour of the subterminal band of the forewing upper (A), the size of the white bars in the subapical area of the forewing upper and under (B), the frequency and size of the red and blue spots on the hindwings, upper and under (C), and the size of the hindwing white or cream postmedian patch upper and under (D).

The variability recorded in this species certainly adds to the beauty of the Fuscous Swallowtail and warrants it as a much-desired visitor to the residential block. Hopefully, the next summer will be another wet summer so we can continue seeing these beautiful butterflies in our suburban gardens.



Figs 1–6. *Papilio fuscus capaneus* reared at Taringa, Brisbane: (1) ♂ emerged 10.i.2022, (2) ♂ emerged 15.i.2022, (3) ♂ emerged 17.i.2022, (4) ♂ emerged 7.i.2022, (5) ♀ emerged 17.i.2022, (6) ♀ emerged 17.i.2022

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Leps in books 4: The Jones' *Icones redivivus*

Roger Kitching

William Jones (1745–1818) (Fig. 1) was a prosperous English wine merchant who, newly married in 1779, and at the ripe old age of 35 'retired' to the Thames-side village of Chelsea to concentrate on his two major passions (presumably in addition to wife, Sarah) of butterflies and painting (Salmon 2000). Jones began illustrating the locally occurring butterflies, gradually expanding his attentions to specimens of adult butterflies arriving in collections in London from all parts of the World.

1

Although forming a significant collection of his own, Jones drew on the great collections of his entomological contemporaries including Drury, Banks, Smith, Francillon and many others. Jones' illustrations were accurate, mostly painted from the actual specimens using the finest (and most expensive) materials of the day. Between 1780 and 1810 he painted 856 species of butterflies and moths in a total of 1292 illustrations organized as seven volumes. Unlike the 1085 paintings from actual specimens which make up Volumes 1 to 6, the 207 images in Volume 7 (simply entitled by Jones as *Papiliones*) are copies of illustrations from other contemporary publications. The images remained unpublished upon Jones' death in 1818. The paintings passed to his cousin, John Drewitt, and remained in the Drewitt family until presented by John Drewitt's grandson to his *alma mater*, Oxford University in 1925–38. The archive became known as the *Jones' Icones* (*icones* being Latin for pictures – as I'm sure I didn't need to tell you) and has been held in the library of the Hope Department of Entomology in Oxford ever since (Fig. 2).

2

Jones' images were of far more than artistic significance. Bear in mind that the great Carl Linnaeus (1707–1778) had published his *Systema Naturae* in 1758 (Linnaeus 1758) applying the binomial system of nomenclature to animals for the first time. This is the genus/species usage that revolutionized zoology and which we use to this day. In 1758 Jones was just 13 but as he grew into his passion for Lepidoptera, he became a dedicated and prominent Linnaean and was among those prominent personages who helped found the Linnaean Society of London in 1788. Jones became a good friend of Linnaeus' best-known pupil, Johan Christian Fabricius (1745–1808), who visited London several times while occupying a Professorship at the University of Kiel. Fabricius was particularly interested in viewing and describing new species from the renowned collections of British lepidopterists such as Dru Drury, Sir James Smith and Sir Joseph Banks. It seems likely that Jones met Fabricius during his first London visit in 1768 and, then and in later visits, Fabricius included scrutiny of the Jones' paintings as well as the actual specimens in the collections of others. A total of 231 butterflies from the Jones' archive were the direct inspiration and model for species' descriptions by Fabricius and the Jones' illustrations are, accordingly, designated as '**iconotypes**' as the material 'anchors' for Fabricius' original descriptions. These then act in lieu of actual specimens designated as 'types' of various kinds (holotypes, allotypes, lectotypes, syntypes, neotypes, paratypes etc) as the cornerstone of modern taxonomy.

So why is all this relevant, in 2022, to Australian naturalists?

Well, first, the full set of Jones 'icones' has now been published for the very first time (Fig. 3) and, second, some of Jones' iconotypes underpin the very first designations of some of our familiar Australian butterflies.

3

The images were held in the Hope Department library in Oxford for about 90 years bound, most recently, as six volumes. During that time they were consulted and referred to by the cognoscenti who visited Oxford. From an Australian viewpoint the most significant of these visitors was the lepidopterist, G. A. Waterhouse, who examined the images twice in 1936. His article on the visit (Waterhouse 1938) attempted to resolve some apparent contradictions in Fabricius' referencing of particular volumes of the *Icones*. An appendix to that paper by Sir Edward Poulton suggested that the paintings had been rebound as six volumes since Fabricius' time (Fabricius had referred to seven volumes) and this had been the source of the confusion which occupied Waterhouse.

The Jones' images were scanned and made available on the Hope Department's website in 2015 but it was only in November 2021 that they appeared in print for the first time – more of that shortly.

Fabricius described butterflies from Australia in two separate publications (Fabricius 1775:1793) (as well as naming a couple of species which occur in Australia but which were described from elsewhere, and in other works). Details of these names, their type material, original location and current status are given in the invaluable but often overlooked volume by Edwards, Newland and Regan (2001).

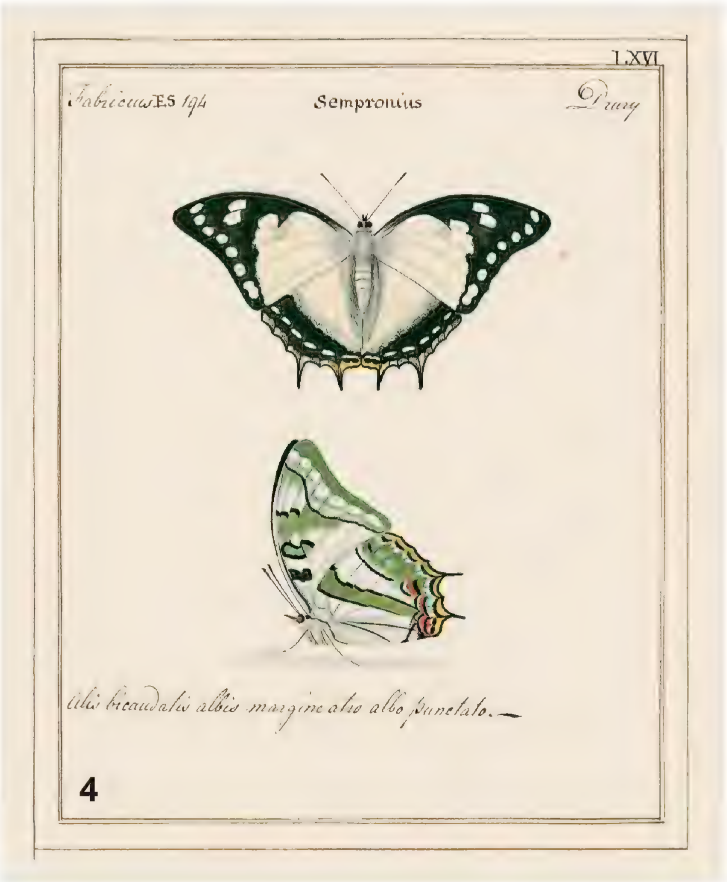
LXVI
Fabricius E.S 194
Sempronius
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Fig. 4. The iconotype of the tailed emperor, *Polyura sempronius*

In 1775 Fabricius described 31 species which occur in Australia. Of these, four were from localities other than Australia. The remaining 27 were described from actual Australian material held in the Banks Collection (that is: on real specimens rather than paintings thereof). All but one of these names have survived as 'good' species' (or, in two cases, subspecies') names. One, *damoetes* Fabricius, proved to be a synonym of *Lampides boeticus* (the long-tailed pea blue), described earlier by Linnaeus in 1767.

The second major work by Fabricius which included descriptions of Australian butterflies was published in 1793. This included ten species names, eight of which are still in use. One, *harmonia* Fabricius, proved to be a synonym of *Cressida cressida* (Fabricius)(the big greasy) and another *zachaeus* Fabricius, of the earlier described species, *Mycalesis sirius* (Fabricius)(the cedar bushbrown). Of the ten it is reasonably certain that seven were described directly from Jones' watercolours and this is a likely explanation for an eighth species. This is even though three of these eight were in the Banks' Collection and probably acted originally as models for Jones' artworks (and which, presumably, Fabricius had seen earlier). Others that Jones used as models may originally have been dispersed from collections made on the Cook voyage but by collectors other than Banks. For these eight, the images in the *Jones' Icones* are appropriately designated as **iconotypes.** They are: *Euploea tulliolus* (the eastern brown crow), *E. sylvester* (the two-branded crow), *Polyura sempronius* (the tailed emperor) (Fig. 4), *Delias argenthona* (the northern jezabel), *Leptosia nina* (the Psyche), *Hypolycaena phorbas* (the common tit), *Leptotes plinius* (the zebra blue) and *Mycalesis zachaeus.* Of these, *Leptosia nina* was probably depicted by Jones from Indian material as was *Leptotes plinius. Mycalesis zachaeus,* as already discussed, turns out to be a synonym of *M. sirius.* This leaves four 'good' Australian species based on Jones' material – *tulliolus, sylvester, sempronius* and *phorbas.* Note that this list differs slightly from that presented on pp. 672–675 of the newly published *Iconotypes* volume and is based on the close reasoning presented in the Edwards, Newland and Regan (2001) volume alluded to earlier.

Finally, then, let me tell you about the fine new volume which has stimulated this article. In November 2021 the publishers Thames and Hudson published the volume fully entitled: *Iconotypes. A Compendium of Butterflies and Moths or Jones' Icones Complete. An enhanced Facsimile.* This is a true doorstop (but heaven forfend you would ever use it as such) comprising 688 pages weighing in at 2.2 kg (according to my bathroom scales). It reproduces, in high quality, all of Jones' watercolours mostly at one per page (with a few at four sheets per page). Reproduction quality is very high and all of Jones' annotations are legible (although mostly in Latin). The work has a foreword by the director of the Oxford University Museum, Professor Paul Smith and is introduced and concluded with thoughtful and fascinating articles by Richard Vane-Wright, distinguished lepidopterist from the Natural History Museum in London. The seven original volumes of Jones' images are interspersed by five articles by other lepidopterists four of whom, variously, discuss the history of butterfly studies and the art of painting them. The final article is a rather out-of-place piece on the current perceived decline in butterflies globally (which contains several odd contradictions in its discussions of both UK and Australian butterflies which I shall not dwell on). This in no way detracts from the superb production values of the volume overall. Should you buy one (and I highly recommend it) then beware of its spine strength – I intend to get a slipcase made for my precious volume. At £65 the book is expensive but does, in my view, represent real value for money – and I doubt the print run was very large. This is undoubtedly destined to become a collectors' item.

Acknowledgement

I am grateful to Caitlin Kirkman of Thames and Hudson publishers, London, for permission to reproduce images from *Iconotypes.*

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Butterfly & Other Invertebrates Club Inc. (BOIC), Butterfly Survey, Boondall Wetlands, Brisbane Saturday 27 November 2021

Dawn Franzmann

The days leading up to this particular Saturday had been plagued with rain and wind. Thought was given to postponing, however, the day before we experienced patches of sunshine and quite clear skies. A decision was made that the key people would still be going and everyone could make up their own minds and if they wished to attend, they could meet us at the designated meeting place.

As it turned out the morning was more or less perfect for walking and observing, not too hot and slightly overcast. Our group consisted of twelve (12) club members and three (3) visitors. A father and his teenage son, Murray and George, who are friends of BOIC members attended. Young George is very keen and would like to study science. He particularly wanted to learn how to use a butterfly net correctly. In a thank you note he expressed his thanks and just how much he enjoyed his learning experience from all the BOIC members present. Before we departed from the Environment Centre, there was a little excitement, as a few Swamp Tigers were very active around some bushes and put on an interesting display at the entrance. An unplanned meeting with another BOIC member who was also enjoying the flights of the Swamp Tigers was most welcomed and she joined us for the walk. Subsequent to this visit, I have seen the Swamp Tigers in the same spot and other BOIC members have reported that they have seen them at the entrance.

We ventured along the Nurri Millen Totem Trail and part of the mangrove section, as we did in September, to complete our second survey of the Boondall Wetlands. The same pattern emerged as previously on our survey of the 11 September. At the beginning of the trail, we easily identified a Dingy Ringlet and a Lemon Migrant with the Glasswings being noticeably fewer in number. Once again, we lingered around the spot where we had seen and identified the Tawny Coster in mid-February 2021 – it was not to be seen today. There has been many confirmed and reported sightings of the Tawny Coster this summer on the western side of Brisbane.

Although this was primarily a butterfly survey, a few members with keen eyes spotted some caterpillars and other invertebrates. Thanks to Annette Dexter and Rip and Janet Curtis.

We had a mid-morning break at the bird hide located in the mangrove section and then returned via the same track to the Environment Centre. A detailed list of our observations, identifications and photos are attached to this report.

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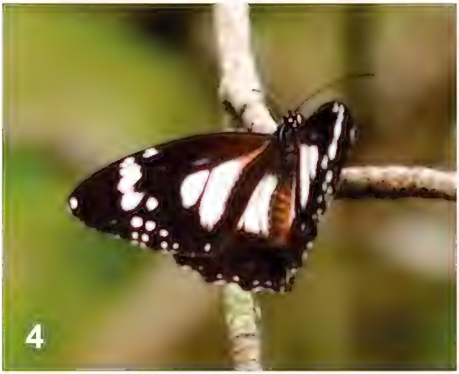
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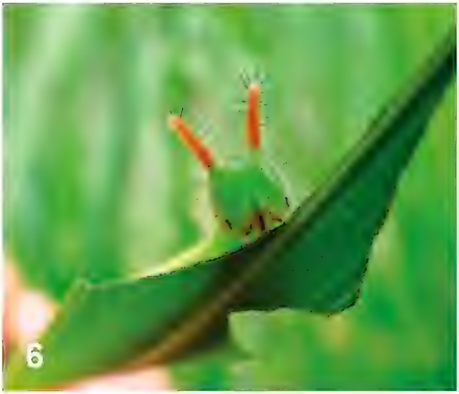
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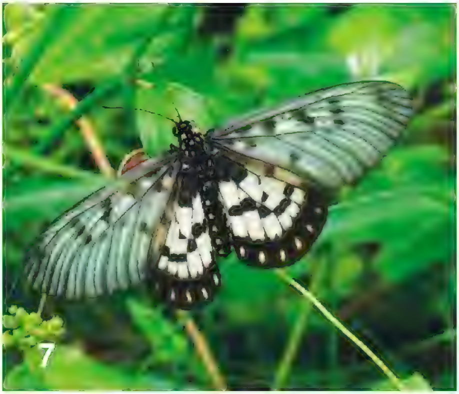
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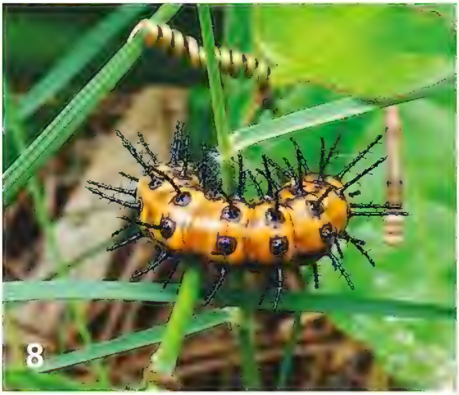
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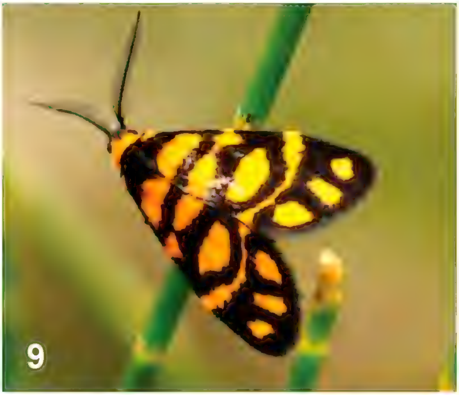
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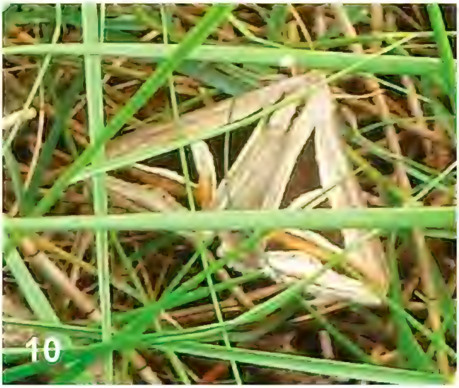
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Fig. 1. BOIC group on the trail, © Rip & Janet Curtis
Fig. 2. Dingy Ringlet, *Hypocysta pseudirius*, © Rip & Janet Curtis
Fig. 3. Small Dusty Blue, *Erina erina*, © Rip & Janet Curtis
Fig. 4. Swamp Tiger, *Danaus affinis*, © Rip & Janet Curtis
Fig. 5. Swamp Tiger, *Danaus affinis* in a collection bottle, soon to be released, © Rip & Janet Curtis
Fig. 6. Evening Brown, *Melanitis leda bankia*, caterpillar © Annette Dexter
Fig. 7. Glasswing, *Acraea andromacha*, © Annette Dexter
Fig. 8. Glasswing caterpillar, *Acraea andromacha*, © Annette Dexter
Fig. 9. Lydia Lichen moth, *Asura Lydia*, © Rip & Janet Curtis
Fig. 10. Triangled Noctuid, *Trigonodes hyppasia*, © Rip & Janet Curtis

BUTTERFLY & OTHER INVERTEBRATES CLUB Inc.
2021/2022 SUMMER BUTTERFLY SURVEY NO. 2
BOONDALL WETLANDS – 27 NOVEMBER 2021
(DATA TO BE INCLUDED IN THE BRISBANE'S BIG BUTTERFLY COUNT)

Common Name/Butterfly	**Scientific Name/Butterfly**	**Nurri Millen Totem Trail & Part of the Mangrove Section**
Lemon Migrant	*Catopsilia pomona*	Collected, identified and released between the hours of 9.30 am and 1.00 pm. **Notes:** Leading up to this day Brisbane had experienced two to three days of heavy rain. Clearing on the Friday afternoon. The Saturday morning was fine, a little overcast, with glimpses of sun through the trees. The temperature was 24°C.
Dingy Ringlet	*Hypocysta pseudirius*	
Glasswing	*Acraea andromacha*	
Small Dusky Blue	*Erina erina*	
Common Crow	*Euploea corinna*	
Large Purple Line Blue	*Nacaduba berenice*	
Common/varied Eggfly	*Hypolimnas bolina*	
Small Green Banded Blue	*Psychonotis caelius*	
Wanderer/Monarch	*Danaus plexippus*	
Swamp Tiger	*Danaus affinis*	
Evening Brown	*Melanitis leda bankia*	
Satin Azure	*Ogyris amaryllis*	
Varied Dusky Blue	*Erina hyacinthina*	
Blue Tiger	*Tirumala hamata*	
Samphire Blue	*Theclinesthes sulpitius*	

Trevor Lambkin, Dawn Franzmann and Russel Denton
Recorders
27/11/2021

Australian Native Bees – Report on the presentation by Dr Tim Heard to our members at our general meeting held on 12 February via the Zoom platform

Bernie Franzmann

Tim began his presentation with an acknowledgement of the First Nation peoples, as the Traditional Owners and ongoing custodians of the land. Indigenous Australians interacted with stingless bees, long before other cultures arrived.

Tim is an Entomologist; an ex-CSIRO research scientist. Tim did his PhD on the use of stingless bees for crop pollination and has been keeping stingless bees for a long time – I think almost 40 years. He is very active in promoting the keeping of stingless bees as pets; which has really caught on.

This was one of the best talks I have heard; professionally presented, fascinating and richly illustrated with high-quality images. If he had the time, I could have listened for hours.

He told us about how bees evolved from wasps. He explained the close relationship between bees and flowering plants. The bodies of bees, in the different families, are structured to carry pollen in different ways. As well as collecting pollen, bees also collect nectar. In social bees, nectar is carried in the alimentary canal, and shared around the hive, with the other adults. Solitary bees mix nectar with pollen to feed their young. Tim explained that bees are professional pollinators. Other pollinators, such as butterflies, moths, flies, bats, etc. are just visiting flowers for a “sugar hit”.

In Australia there are four major bee families (Colletidae, Halictidae, Megachilidae, Apidae).

The Colletidae are unique among bees, in that they line their brood cells with a cellophane-like material. All members of the family are solitary.

The Halictidae usually construct nest burrows in the ground. They may be solitary or communal.

The Megachilidae include the well-known, leaf-cutter bees, which cut neat leaf disks out of leaves, which they use to make their nests. They are solitary bees.

The Apidae include all the highly social bees, including the honey bee and the native stingless bees.

To illustrate these families, he showed us and told us about, Cellophane Bees, Carpenter Bees, Blue-Banded Bees, Reed Bees, Resin Bees, Cuckoo Bees, Teddy Bear Bees and Stingless Bees.

After giving us a run-down on bee issues, he took us, digitally, down to his backyard. Making a detour, on the way, he showed us a potter wasp, constructing its nest close to a painting of a Grecian urn – an ancient pot. What a juxtaposition: the Greeks developed pottery less than 4000 years ago but the potter wasp was constructing "pots" about 100 million years ago.

Tim showed us a bee hotel (Fig. 1) with different structures, substrates and hole sizes, to accommodate different bee and wasp species. He opened a couple of native stingless bee hives, and showed us some of the structures and explained their function.

One concept will stay with me – Because of the close and critical relationship between bees and the evolution and spread of the flowering plants, about 130 million years ago, bees may be considered to have coloured and perfumed the world – what a remarkable and beautiful idea.

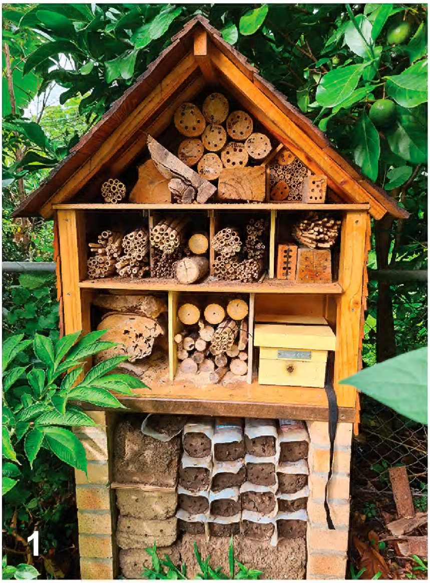

Fig. 1. Tim's bee hotel

Thanks, Tim, for a wonderful presentation. I would like to add, that the presentation was skillfully done with the use of the modern technology of Zoom, combined with, the not-so-modern, mobile phone.

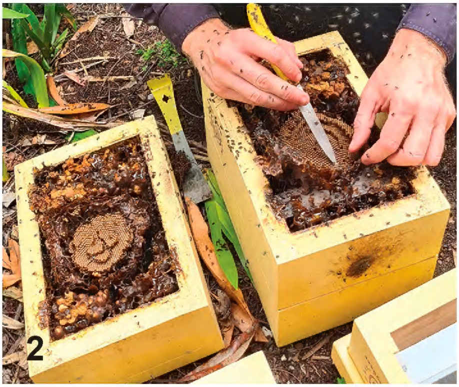

Fig. 2. Tim splitting a hive

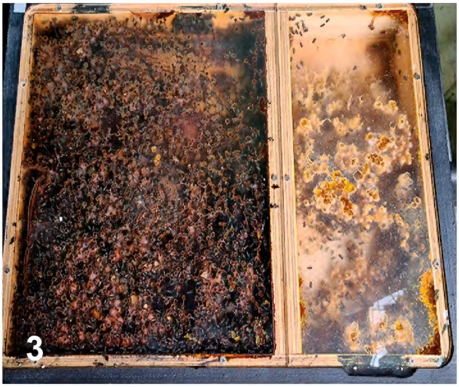

Fig. 3. Two species hive

COVER IMAGE

Black Rock Scorpion (*Urodacus manicatus*)
Girraween National Park, Stanthorpe, Qld

The Black Rock Scorpion is a common species of large mildly-venomous scorpion, found in cool upland areas of southern QLD, NSW and VIC with some isolated populations in SE South Australia. As the common name implies, they are rock specialists and can be found under loose stones or in crevices of exfoliating rock, ranging from granite, to basalt, to sandstone and conglomerate. They are formidable predators and are able to overpower any animal its size, including other predatory invertebrates and even small lizards and frogs. These scorpions are heavily poached for the pet trade and as a result, in some parts of southern NSW, are facing local extinctions. They are also at threat from fires, land clearing and weed invasion, like a majority of species. This current species *manicatus* is likely to be a massive species complex, as there are low levels of interbreeding between populations (Alexander Davies).

GUIDELINES FOR AUTHORS

Text to be 11 font size Times New Roman with 1.5 times New Roman spacing. Images are to be a minimum of 300dpi, originals separate to the document and captions provided for each image. Adherance to the deadlines for submission would be greatly appreciated.

All articles/contributions to be submitted to the Editorial Committee at secretaryboic@gmail.com.

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